Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensland.

PUBLICATION No. 165.

GOLD, PLATINUM, TINSTONE, AND MONAZITE

IN

THE BEACH SANDS ON THE SOUTH COAST,

QUEENSLAND.

With Appendices on the Beach Sands of New South Wales, and on the Physical Properties, Sources, and Uses of Platinum.

WITH 3 PLATES AND 2 FIGURES.

BY LIONEL C. BALL, B.E.,

Mining Engineering Geologist.

BRISBANE:

THOMAS MUIR, GOVERNMENT PRINTER, WILLIAM STREET.

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1905.

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GOLD, PLATINUM, TINSTONE, AND MONAZITE IN THE BEACH SANDS ON THE SOUTH COAST OF QUEENSLAND.*

INTRODUCTION.

In May last a sample of brown concentrates from the auriferous sands of the South Coast was delivered at the Geological Survey Office for examination as to the presence of platinum.

A number of minute flattened grains of a white lustrous metal were obtained by carefully panning off the accompanying minerals. These grains were dissolved in *aqua regia*; the solution was evaporated to dryness, and the salt remaining was then dissolved in water. The addition of potassium iodide caused the formation of a deep rose colouration, proving the presence of platinum.

The concentrates consist chiefly of well-rounded grains, though a few prismatic crystals are also to be seen. The grains are red-brown and honey yellow (tinstone and monazite), white (zircon, topaz, and quartz), black (magnetite and ilmenite), and greenish (tourmaline).

The presence of phosphates (monazite) was proved by heating the powdered material with a drop of sulphuric acid, and to the dried residue adding ammonium molybdate with excess of nitric acid, when, on evaporation the yellow colour of ammonium phospho-molybdate was obtained.

The Government Analyst found the same sample to contain 4.3 per cent. of the cerium group of earths (calculated as oxides, and including 0.4 per cent. thoria) together with phosphoric acid.

On heating the powdered concentrates mixed with soda carbonate and potassium cyanide on charcoal before the blowpipe, a bead of metallic tin was obtained, proving the presence of cassiterite.

Mr. Rands in his report on the Albert and Logan district,† published in 1889, refers to the layers of black sand containing gold, on the beach between the mouth of Nerang Creek and Tweed Heads, but no mention is made of platinum, tinstone, or monazite. Mr. Rands was of opinion that the gold came from the siliceous rocks up the creeks. He further says that at the mouth of Currumbin Creek several

* With Appendices on the Beach Sands of New South Wales, and the Physical Properties, Sources, and Uses of Platinum, with two Plates and three Figures.

† No. 51 of the G.S.Q. Publications.

layers from one to six inches thick had been worked, one at a depth of 16 feet yielding four ounces of gold in a week, but water in the sands was giving a good deal of trouble.

In the following pages it is shown that at intervals along the Currumbin-Coolangatta Beach the sands contain payable tin, accompanied by gold. The concentrates, however, assay very much lower than was expected, and the assays show that the work thus far done for tin has been at a loss—either owing to local poverty of the ground or to escape of tinstone with the tailings. Nevertheless the hope is entertained that the ground may yet be proved sufficiently rich for dredging.

LOCALITY AND TOPOGRAPHY.

The ground likely to be auriferous lies between the mouth of Currumbin Creek and Point Danger, a total extent of five miles.

On the north-west of the area, within one and a-half miles of Currumbin Creek, are several outcrops of schists and slates forming low hills and ridges—the extremity of Macpherson's Range. At the south-east, for a little over a mile from Point Danger, there are areas of clay-slate capped in great part by dolerite. The intervening lowlands consist of sand dunes and swamps, there being not a single rock outcropping along the beach for a distance of three miles.

The southern boundary of this ground is determined by Cobaki Creek (in New South Wales), the average width of the ground being one and a-half miles; only one-half of it, however, is in the State of Queensland.

The sand, as in New South Wales, is grouped into long low ridges running parallel to the present beach and separated by flat, sometimes swampy, ground. The dunes in this locality never reach a greater elevation than 20 feet above high-water mark, this being in part due to the great hold which the stunted vegetation has secured upon the sand.

The inference is inescapable, on viewing the ground or the map, that this area was formerly an inlet of the sea into which Cobaki Creek emptied itself. The continual throwing up of sandbars by the combined action of the river and the sea, and the infilling of the lagoons thus formed, account for the reclamation. Such action can now actually be seen in progress at the present mouth of the Tweed River.

It is believed locally, however, that the sea has during the last twenty years encroached on the land at Currumbin Beach from one to three chains.

GEOLOGY.

The only place where anything of the structure of the sand deposits can be seen is in the bank (1 to 15 feet in height) on the upper edge of the beach. As this is continually being broken down the

Photo. L.C.B.

PLATE 1.—BLACK SAND SEAMS EXPOSED IN BANK, CURRUMBIN BEACH.

Photo. L.C.B.

PLATE 3.—WORKING WITH SLUICE BOXES, CURRUMBIN BEACH.

alternating layers of black and white sand forming it are exposed to view. The black layers vary from a fraction of an inch to 18 inches in thickness. In a very few places they are entirely absent, but often they are found from top to bottom of the bank, increasing in thickness towards the bottom. (*See* Plate 1.)

The greater part of the beach is, after storms, covered with a layer of black sand, sometimes over a foot thick, but more often only a few inches, in which latter case underneath it are generally alternating layers of white and black sand.

The concentration can be observed in progress. It is due simply to the power of the incoming waves during heavy southerly and south-easterly gales to carry all the finer material (white sand, black sand, tinstone, gold, &c.), to the upper part of the beach, while in retiring they carry off only the white sand. Thus, the black sand tends to increase in the upper part of the beach, and, for the same reason, that part has always proved richest in gold.

In prospecting the surface sands along the beach, it was noticed that the parts richest in gold were those in which brownish tinstone could more readily be distinguished, because of the concentration there being a little "closer."

It is possible that in the beach concentration of the heavier minerals also takes place, as in ordinary stream alluvium, by their sinking through the saturated sands, and causing enrichment of the lower layers, though no proof of this can be offered.

Origin.

The origin of similar deposits in New South Wales, which have been studied to a far greater extent than ours, has not been definitely determined, though many suggestions have been offered.

The ilmenite and magnetite, it may be taken, have been derived from the decomposition and erosion of the basalt sheets which formerly capped this part of the coast (as proved by the numerous outliers still to be seen). That the gold has been derived from the same rock is not beyond the bounds of probability, it having been reported as occurring in diorite in Russia, South Africa, and Victoria. The platinum is even more likely to have occurred originally in the basalt, though its parent rock is believed to be ultra-basic.

It has been suggested that the gold has been derived from reefs in the basal slates. In certain parts reefs—generally almost barren—are very numerous; and again, there are large stretches, as in the locality under discussion, where there are no reefs. Reefs may, nevertheless, have contributed to the supply.

The remaining theory is that the heavy minerals have been carried down from the Stanthorpe-New England tinfields, a distance of

nearly 100 miles in a straight line. Even with the fall of 3,000 feet, it is difficult to conceive that the minerals should have travelled such a distance. It is more feasible that they have been derived from rocks, either slates or basalt, in the immediate neighbourhood, in which they occur in too small quantities to have yet been detected.

METALLIC CONTENTS.

Colours of gold were found (in May last) in the black sands on the present beach in almost every spot tested, and the prospects obtained near the old shipwreck, three-quarters of a mile south-east of the Flat Rock (one mile south of Currumbin Creek) were sufficiently encouraging for the ground to be worked, but in September most of the black sand had disappeared. Though the gold may not have been present in payable quantities in the majority of cases, its presence at all certainly pointed to the lower sands being worth prospecting.

Miners now working on the beach affirm that there is, towards Coolangatta Creek, a rich 12-inch layer at a depth of from six to eight feet.

They believe that the seam continues uninterruptedly from Flat Rock, and that it dips south-east along the beach as well as seawards; so that, though above high-tide mark at Flat Rock, it is considerably below at Coolangatta. Owing to the spring tides prevailing, we were unable, in September, to reach the seam more than half a mile south-east of Flat Rock. At that point it is 18 inches thick, and a sample from it assayed (Government Analyst):—

Tin	0.18 per cent.
Gold	12 gr. per ton
Silver	4 dwt. 2 gr. per ton
Platinum	trace.

The above is equivalent to 5.12 lb. tinstone per ton, and it probably equals 1½ lb. tinstone to the yard from the surface.

A mile south-east of Flat Rock there are alternate black and white seams from the surface to four feet depth, with a six-inch seam of black sand at the bottom. A sample from the whole four feet yielded (Government Analyst):—

Tin	0.17 per cent.
Gold	1 dwt. 19 gr. per ton
Silver	3 dwt. 22 gr. per ton
Platinum	trace.

This is equivalent to 4.84 lb. tinstone per ton.

A sample washed here yielded an equivalent to 7.7 lb per ton.

Another sample was taken from a six-inch seam at five feet depth in the bank (at about the level of the highest tide), 1½ miles south-east of Flat Rock, and yielded (Government Analyst):—

Tin	trace
Gold	1 dwt. per ton
Silver	4 dwt. 10 gr. per ton
Platinum	trace.

A sample washed off in the pan yielded 12 gr. to the pound, which is equilavent to 3.8 lb. per ton.

Prospects from a seam in the bank three-quarters of a mile north-west of Coolangatta Creek showed from ⅓ lb. to 1 lb. tinstone per ton.

A sample from a six-inch layer at the surface of the beach at the shipwreck, five-eighths of a mile north-west of Coolangatta Creek, yielded (Government Analyst):—

Tin	0.64 per cent.
Gold	17 gr. per ton
Silver	4 dwt. 20 gr. per ton
Platinum	trace.

This is equivalent to 18.21 lb. tinstone per ton.

The white sand on the beach hereabouts contained from $\frac{1}{10}$ lb. to 4 lb. to the ton, as well as colours of gold.

In order to try and reach the deeper seams, a hole was sunk two chains back in the "terrace," 200 yards north-west of the mouth of Currumbin Creek, but water was struck at a depth of ten feet and prevented further sinking. At eight feet depth is a four feet layer of brown sand, stained by peaty water, and this yielded 3 gr. of tinstone to the pound, equivalent to almost 1 lb. to the ton.

A 15-feet bank, 15 chains north of Coolangatta Creek, yielded traces of tinstone and specks of gold.

The seven-feet bank of brown sand east of Coolangatta Creek prospected ⅓ lb. tinstone per ton, but probably contains many times as much. At this spot there are several thin seams totalling 18 inches, two feet under the beach, prospecting $\frac{1}{10}$ lb. per ton.

At the mouth of Flat Rock Creek, a few chains north of Flat Rock itself, and at the bottom of the bank is a four feet band of black seams, which prospected ¾ lb. per ton, and assayed (Government Analyst):—

Tin	0.26 per cent.
Gold	1 dwt. 7 gr. per ton.
Silver	7 dwt. 2 gr. per ton.
Platinum	trace.

This yield is equivalent to 7.39 lb. tinstone per ton.

(For other assays see under "Workings.")

WORKINGS.

Two claims were, at the time of my first visit, held at the north-western extremity of the beach, near Flat Rock.

In one, just pegged out, a hole had been sunk to the "wash" but had been filled up again through the sea breaking-in.

The other claim, about two and a-half chains south of Flat Rock, had been worked for some months, and had lately changed hands; so that the owners, having put through only four loads, could give me little information as to the contents of the ground.

A 12-inch seam of black sand and a two-inch seam a few inches below it yielded the gold, and to get at them it was necessary to remove six feet of overburden (black and white sand in alternating layers). The seams dipped seaward at a slightly greater angle than the present beach.

A few pounds of the sand were taken from the face of the seam exposed—only a few feet in width—and the Government Analyst found traces of gold and silver, but no platinum. It is, however, recognised that the platinum does not occur distributed througout the whole of the sand, being often conspicuously absent during many days' work.

A small sample of the tinstone, monazite, and platinum concentrates was seen, in which the platinum amounted to many ounces to the ton.

At the time of my second visit (in September) the miners, still working in the same locality, about two and a-half chains south of Flat Rock, had combined, and pegged out the whole of the beach between Coolangatta and Currumbin Creeks as a dredging area. The width of the area north of Flat Rock is only about three chains, while southward it extends back five to ten chains, to the railway line.

A hole had then been sunk in the "terrace," two chains back from the beach, to the west of the workings. At five feet depth it passed through a four-inch seam of black sand (reported to carry 12 gr. of gold and platinum), 15 inches grey sand (with tinstone), and 17 inches black and white sand. A sample from the whole three feet, including black and white sand, assayed (Government Analyst):—

Tin	trace
Gold	5 gr. per ton
Silver	3 dwt. 22 gr. per ton
Platinum	trace.

These seams, though on about the same level, have been proved by the miners to be distinct from those worked on the bank just above the beach.

Photo. L.C.B.

PLATE 2.—WORKING WITH COPPER PLATE- AND BLANKET- BOX, CURRUMBIN BEACH.

In the present workings, near the edge of the bank, their main seam (12 inches to 15 inches thick) is six feet deep. A sample from the seam where exposed yielded (Government Analyst):—

Tin	0.12 per cent.
Gold	trace
Silver	3 dwt. 12 gr. per ton
Platinum	trace.

This is equivalent to 3.42 lb. tinstone per ton.

Just beneath it is a thin seam two inches to six inches thick, generally very rich in gold, while about a foot above it is a four-inch, practically barren, seam.

About three chains south-east of the paddock there is a four feet seam of black platiniferous sand at five feet depth, a sample from the upper part of which contained (Government Analyst):—

Tin	trace
Gold	5 gr. per ton
Silver	4 dwt. 22 gr. per ton
Platinum	trace

TREATMENT.

In prospecting, very great difficulty is experienced in saving the gold, platinum, and tinstone, owing to their extreme fineness and the high specific gravity and comparative coarseness of the associated minerals. For this reason it is practically useless to attempt to estimate the contents by vanning, especially of samples weighing more than two pounds. Accurate results can, therefore, be obtained only by chemical analysis.

The treatment employed till quite lately consisted in passing the auriferous sand over copper and blanket tables, the arrangements shown below being employed. The black sand was thrown into the perforated hopper, and sea water, pumped on to it, carried it through to the spreading tray and over a mercury feed-riffle on to the copper plate, and thence on to the blanket table. The tailings then passed into the sump box, out of which they were shovelled on to the dump. (See Plate 2 and Fig. 1.)

Most of the gold was caught on the copper plates, while platinum, tinstone, and monazite remained on the blanket table, where it was

found that Brussels carpet proved much more efficacious than blanket in saving the heavy minerals.

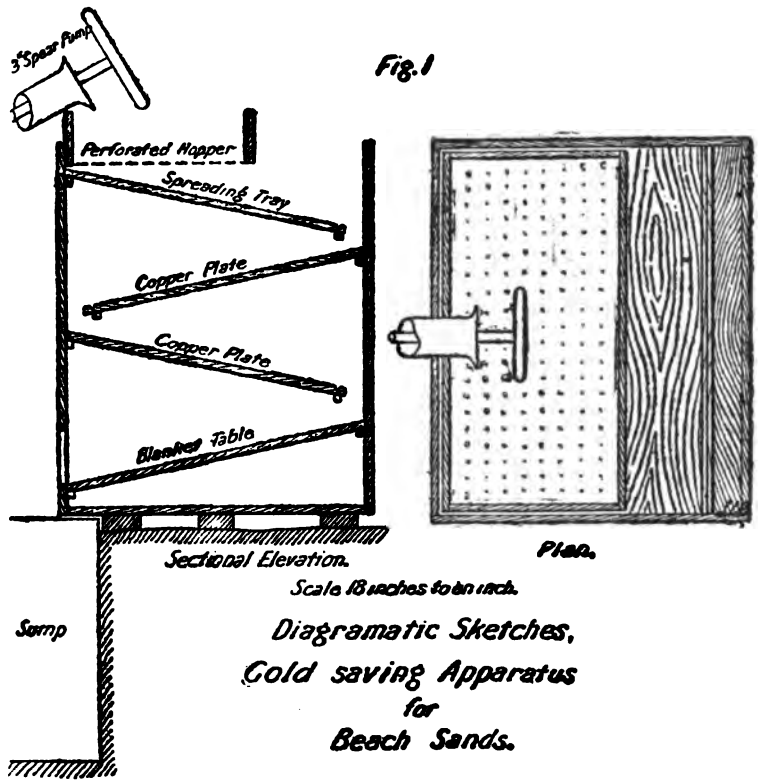


FIG. 1.—DIAGRAMMATIC SKETCHES, GOLD-SAVING APPARATUS FOR BEACH SANDS.

The above method failing to give satisfaction in new hands (partly owing to the difficulty experienced in keeping the copper plates bright), an entirely new arrangement has now been devised. (See Plate 3.) This consists essentially of 30 feet of blanket tables 15 inches wide, with an inclination of 1 in 5, this having been proved experimentally to give the best results.

Water is raised from the well-hole (to which it has first been carried in buckets from the sea) by a spear pump discharging on to the perforated box, into which the sands are thrown. The lighter sands are washed down over the blankets to the sump, from which the tailings have to be shovelled on to the dump, while the water is returned to the well.

Three men are required to work the plant—one feeding sand, one pumping, and one removing tailings from the sump.

The plant has been in operation two weeks, during the first of which 191 lb. of concentrates were obtained, assaying (Government Analyst):—

Tin	8.3 per cent.
Gold	1 oz. 16 dwt. 8 gr. per ton
Silver	12 dwt. 19 gr. per ton
Platinum	trace.

This is equivalent to 10.54 per cent. tinstone—*i.e.*, 20 lb. tinstone, worth, at 7d. per lb., 11s. 8d.

During the second week a total of half a ton of concentrates was separated from 20 tons of black sand. Those from the upper blankets, amounting to three cwt. contained (Government Analyst):—

Tin	1.69 per cent.
Gold	7 dwt. 5 gr. per ton
Silver	5 dwt. 5 gr. per ton
Platinum	trace.

This is equivalent to 2.15 per cent. tinstone—*i.e.*, 7¼ lb. tinstone obtained, worth 4s. 2¾d.

Those from the lower blankets (seven cwt.) contained (Government Analyst):—

Tin	0.10 per cent.
Gold	22 gr. per ton
Silver	5 dwt. 3 gr. per ton
Platinum	trace.

This is equivalent to 0.13 per cent. tinstone—*i.e.*, 1 lb. tinstone, worth 7d.

These returns show plainly that the results have hitherto not justified the work done. The assays given in previous pages show that the sands contain, at least in parts, payable quantities of tin. The 20 tons of black sand put through in the second week should have yielded 70 lb. of tinstone, which would have been worth £2.

The miners' estimate that they have averaged a ton of black sand for each 10 square feet of the claim so far worked, and this agrees with the calculated yield. It has been shown that 20 tons of black sand yielded ½ ton of concentrates containing 8¼ lb. of tinstone, to obtain which it is necessary to shift 60 tons of overburden, the yield per ton of material moved being thus 0.14 lb. of tinstone. (It was expected by the miners that the tinstone would amount to 2 cwt.)

It was proposed to instal a 2-inch pump, throwing 1,000 gallons an hour, worked by a 2 horse-power oil engine, consuming one pint of oil per horse-power per hour (or one case of kerosene, at 5s. 6d., per week).

A further contemplated improvement is a scoop worked by a horse, by means of which the bank may be worked down in a face from the sea.

The result of these improvements should be a greatly reduced handling of the material (the tailings being run out on to the beach),

an increased turnover, closer concentration, and consequently a greater profit, enabling more thorough prospecting to be carried out with a view to the ultimate dredging of the ground.

For the treatment of the sands between tides the surf washer described in the "Mining and Scientific Press" of San Francisco, and the "Queensland Government Mining Journal"* from which the accompanying illustration has been taken, should give good results.

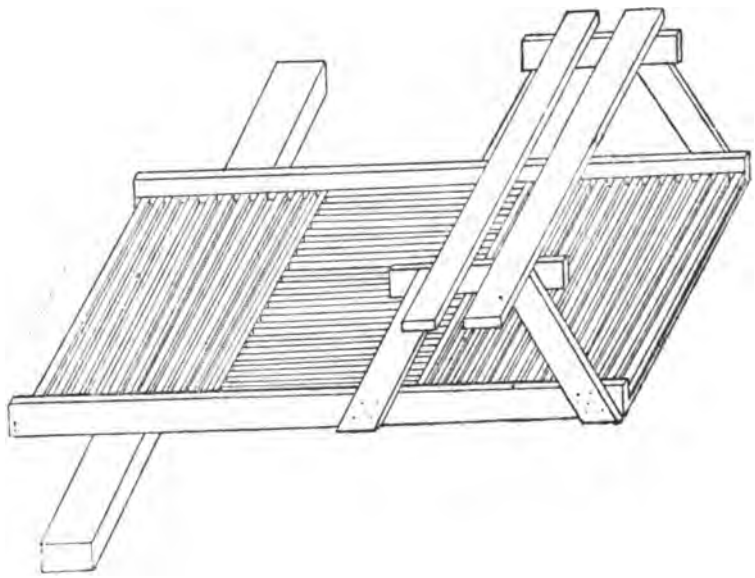


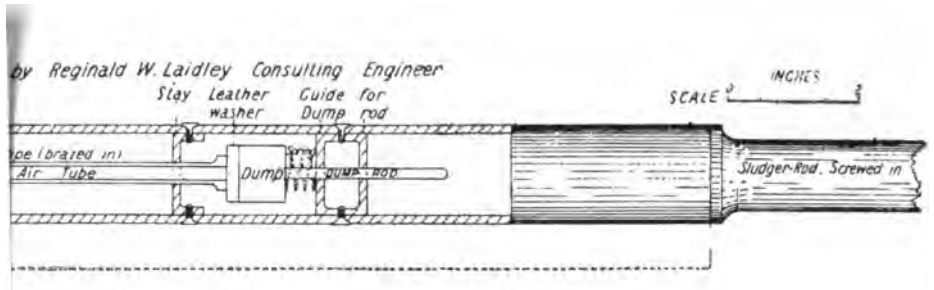
FIG. 2.—SURF WASHER FOR BEACH SANDS.

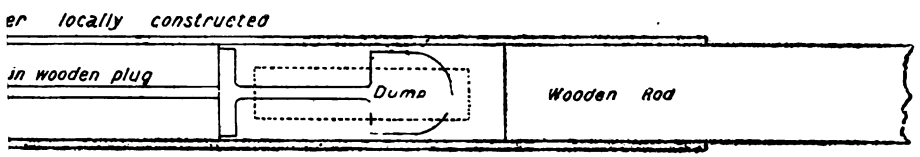
The sluice box is 8 to 12 feet long and 3 or 4 feet wide, with sides raised 2 or 3 inches above the riffles, which are divided into sections for cleaning up. Amalgamated copper plates may also be used, and quicksilver should in any case be placed in the riffles. The box (inclined 1 in 14 to 1 in 18) is weighted down, within reach of the waves, by sand bags on the crosspiece at one end and the raised platform at the other. The riffles shown are square in cross-section, but they would probably give better results if cut back beneath on both sides, so that their cross-section would be trapezoidal.

PROSPECTS FOR SLUICING OR DREDGING.

It is recognised that it does not pay to work the seams as at present with sluice boxes, but it is held that, with a pump and engine on the ground, the most laborious part of the work (carrying water from the surf and raising it to the tables) will be obviated, and there seems to be every probability of the work being profitable, especially if, as proposed, a horse and scoop be employed also.

* Vol. IV., 1903, p. 643.





in pipes SCALE 0 1 2 3 4 INCHES

The results thus far obtained indicate this to be a very favourable field for a dredger. The matter should, however, before installation of expensive plant, be put beyond doubt by a thorough prospcting by boring. The contents might be ascertained by putting down bores, 100 feet apart, over the whole area, but a preliminary test might be made with one bore to every ten acres.

Mr. Joseph E. Carne, F.G.S., Geological Survey of N.S.W.* has briefly described and illustrated sludgers used in prospecting in New South Wales. (Fig. 3.)

Those made locally consist of a section of gaspipe, tempered and fitted with two rectangular opposite openings near the upper end, and a perforated wooden plug valve and metal dump. Lining tubes for the sludger holes consist of two lengths of gaspipe or ordinary galvanised spouting of a slightly larger diameter than the sludger barrel. A chisel-shaped cutter might be affixed to the upper end of the sludger rod to facilitate passage through hard bars. The sludger rod is of light pine, and 16 feet to 18 feet in length.

An improved sludger, designed by Mr. R. W. Laidley, of Sydney, consists of a short steel barrel, about 2 feet long and 1½ to 2 inches in diameter, fitted with an air-tube and spring dump, or a ball and clack valve.

The sludger is worked like a jumping rod, the fall of the tool being followed by a semi-rotary boring motion. In prospecting with the machine a hole is sunk 3 feet deep, in which a man can stand and gradually press the lining tube down with a semi-rotary motion. When two lengths of lining tube are used the shorter is first put down to the level of the 3-feet hole, and then withdrawn by means of a rope, and the longer inserted, this procedure obviating the erection of a raised platform.

The simpler sludger first described has been tried at Currumbin, and is found to work satisfactorily in dry sand, though it is almost as quick to sink by shovel down to depths of 14 feet. It, however, failed entirely when the sand contained water. For such ground it will, therefore, be necessary to affix a rough clack-valve to the interior of the bottom of the cutting pipe. This will open to allow the sand and water to enter, but fall back, retaining the material as the sludger is raised.

Special experiments will have to be carried out to determine some method of saving the valuable minerals—the gold, platinum, tinstone, and monazite; for, as already mentioned, their extreme fineness has caused much trouble in separating them from the heavy black sands. Magnetic separation should give good results as far as

* Annual Report of Department of Mines and Agriculture, N.S.W., for 1895, p. 158.

the gold, tinstone, and monazite are concerned, but the platinum, being generally ferriferous and magnetic, would be carried away with the ironsand.

OTHER OCCURRENCES.

It may be as well here to note that black sands occur at numerous points on the Queensland coast between Currumbin and Burleigh Heads, from Burleigh Heads to Southport, at the north and south ends of Stradbroke Island, at Noosa, and at Geraldton.

Auriferous beach sands have been worked on the North Coast of New South Wales, as described in Appendix A.

In New Zealand the sands are on tertiary terraces (and in the streams intersecting them), on raised terraces (some of which are over 200 feet above the present sea-level), and on the present sea beaches. On the North Beach, five miles from the Maori River, platinum is found associated with gold.

It is believed that the non-success in the dredging of the New Zealand beach sands has been chiefly due to the employment of dredging machinery designed for totally different conditions.

Beach sands have also been worked for gold in Oregon, U.S.A., and Hakodaki, Japan.

Brisbane, 2nd November, 1904.

APPENDIX I.

The Beach Sands of New South Wales.

Discovery.—The discovery of gold in the beach sands of New South Wales was made in 1870, and was followed by a rush of miners from New Zealand.

Extent.—Though auriferous sands are found from the Queensland border to Port Macquarie, and again in the vicinity of Wollongong, the richest localities are in the North, near Byron Bay, Broken Head, and Evans Head, where the yield was up to £800 per man for six or nine months' work.

The mining has always been of an intermittent character, as the ground depends for enrichment on the south-easterly gales.

The deposits at the Evans River have been described* in detail by Mr. G. A. Stonier, F.G.S. After referring to the streaks of black sand on the present sea beach, and in a slightly raised sea beach covered by from 3 to 16 feet of drift sand, he goes on to describe those in the "back terraces."

McAuley's lead, one of these lying three-quarters of a mile inland, was discovered in 1895. It occurs on the eastern side of a long narrow

* Records of the Geological Survey of New South Wales, Vol. IV.

sand dune, its workable width being from 14 to 30 feet. The line of claims was two miles long, the southern extension being poor. The black sand layer on the western side of the lead is a streak, but increases in thickness and decreases in richness towards the east.

Mr. Stonier favours the idea that the slates have been the source of the gold.

Contents.—The sands contain rounded grains of ilmenite, magnetite, zircons, quartz, and cassiterite, with small scales of platinum, iridosmine, and gold. The platinum is generally present in traces only, while the gold varies from a trace up to 1½ oz. per ton.

The characteristics of the sand are its high specific (4.42), its fineness, and its dark colour.

The concentrates contain from 20 oz. per ton, up to 43 per cent. platinum, and up to 51 per cent. cassiterite.

The amount of gold produced up to 1891 was 400 oz.

Origin.—Mr. J. E. Carne, F.G.S., Geological Survey of New South Wales, discusses* the following possible sources of the gold, platinum, and tinstone in the sands:—

(*a*) The underlying Siluro-Devonian rocks which contain poor quartz reefs.

(*b*) The Clarence Coal Measures.

(*c*) Drifts under basalt, known to occur and to be slightly auriferous.

(*d*) The basalt, doubtful crushings reported.

(*e*) The drainage channels from New England.

Mr. Carne inclines to the opinion that the earlier drainage channels (the drifts), as well as the present, have fed the auriferous beaches.

APPENDIX II.

Physical Properties, Sources, and Uses of Platinum.

Physical Properties.

Platinum is a steel gray, lustrous, highly malleable, and ductile metal, crystallising in the cubic system.

Native Platinum consists of an alloy in variable proportions of platinum, iron, iridium, osmium, &c., its specific gravity varying accordingly between 13½ and 19, and its hardness between 4 to 4.5 (*i.e.*, a little greater than calcite). Both magnetic and non-magnetic varieties are found, the specific gravity of the former being the lesser, while its hardness is greater (up to 6). Its magnetism is probably due to the high percentage of iron.

* Records of the Geological Survey of New South Wales, Vol. V.

The metal is quite infusible in ordinary furnaces, and is soluble only in *aqua regia* (a mixture of hydrochloric and nitric acids).

Native iridium is a silver white alloy of iridium with platinum, &c., occurring with platinum in the Urals and in Brazil. Its hardness is 6-7 (felspar to quartz), and its specific gravity is about 22.75.

Iridosmine is a tin white, lustrous, but only slightly malleable alloy of iridium and osmium, generally containing rhodium, platinum, ruthenium, &c. Its hardness is between 6 and 7, and its specific gravity varies from 19.3 to 21.12.

On heating with nitre, oxidation of the osmium takes place. The mineral occurs with platinum in South America, in the Urals, in New South Wales (Bingera, Bathurst, &c.), and abundantly in the auriferous beach sands of Northern California (bright lead-coloured scales); and it is also found in Canada.

Sources.

South America.—The first record of the occurence of platinum dates from the year 1735, when the metal was brought by a Spanish traveller from South America, having been found associated with iridium, osmium, palladium, gold, copper, and chromite in the sands of the Rio Pinto, near Popayan, Colombia. It derives its name from the Spanish plata (meaning silver) in reference to its colour and lustre.

Its occurrence in Brazil was reported in 1826, it being said to occur in syenite.

Europe.—In 1822, platinum was discovered at Nizhni Tagilsk, in the Urals, in alluvial. It also occurs with chromite in serpentine, which is believed to be an altered peridotite.

In Lapland also, where it is associated with the diamond, it is thought to have been derived from a chrome-bearing serpentine.

It has been found in sands in Wicklow (Ireland), on the Rhine, in France, in Honduras, and in San Domingo.

North America.—Platinum has been found in Alaska and British Columbia in auriferous wash, in Quebec, in North Carolina, in California, and in Oregeon (beach sands).

Australasia.—Platinum has been reported from Borneo; from New Zealand (in drift in the River Tayaka, in a serpentine and dunite region, and the Gorge River, in quartz lodes in the Thames region, and in the auriferous sands of North Beach, five miles from the Maori River); and from New South Wales (*in situ* near Broken Hill, and in the auriferous beach sands of the North Coast, as described in Appendix I.).

Uses.

The greater part of the supply of platinum is used in the manufacture of crucibles, foil, and wire, its infusibility and comparative insolubility rendering it indispensible to chemists.

It is employed generally as an alloy in various parts of mechanical instruments of precision, where either permanency or hardness is required. As an alloy it is also used for tipping the nibs of fountain pens.

The metal is employed to a large extent in electrical industries—for fusing in glass, its coefficient of expansion being almost exactly that of glass, so that no disconnection takes place through change of temperature. Platinum has also been used for the filament in electric glow lamps, and for electrodes.

It is used in photography to a slight extent, and it has in the past been employed in Russia for coinage.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensland.

PUBLICATION No. 199.

PRELIMINARY REPORT

ON

RECENT DISCOVERY OF GOLD AT OAKS VIEW,

NEAR

ROCKHAMPTON.

(WITH 2 PLATES.)

By LIONEL C. BALL, B.E.,
ASSISTANT GOVERNMENT GEOLOGIST.

BRISBANE:
BY AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.
1905.

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1905.

LETTER OF TRANSMITTAL.

Geological Survey Office.
Brisbane, 23rd January, 1905.

SIR,—I have the honour to forward, under separate cover, my Report "On the Recent Discovery of Gold at Oaks View, near Rockhampton," with one plan and two plates.

I have, &c.,

LIONEL C. BALL,
Assistant Government Geologist.

The Under Secretary for Mines.

L.C.B., Photo.

PLATE 1.—OAKS VIEW HILL *(from the west).*

L.C.B., Photo.

PLATE 2.—MAIN WORKINGS, OAK VIEW.

RECENT DISCOVERY OF GOLD AT OAKS VIEW, NEAR ROCKHAMPTON.

LOCALITY.

Oaks View Hill lies nearly in the centre of grazing farm No. 1v, Canoona, four miles north of the Oaks Station. It is distant, by road, 45 miles from Rockhampton, *viâ* Yaamba, Junction Hotel, Canoona, and the Oaks Station; or, instead of the last, *viâ* Isla Park. The new route to the mines passes Isla Park, keeping to the main Broadsound road till within three miles of the hill. The main road is kept in excellent condition, but the country between it and the hill consists of both broken gullies and black soil flats, and the latter will give great trouble in wet weather. However, there is an alternative route leaving the Broadsound road some miles further to the north, and this, though longer, will prevent absolute isolation.

TOPOGRAPHY.

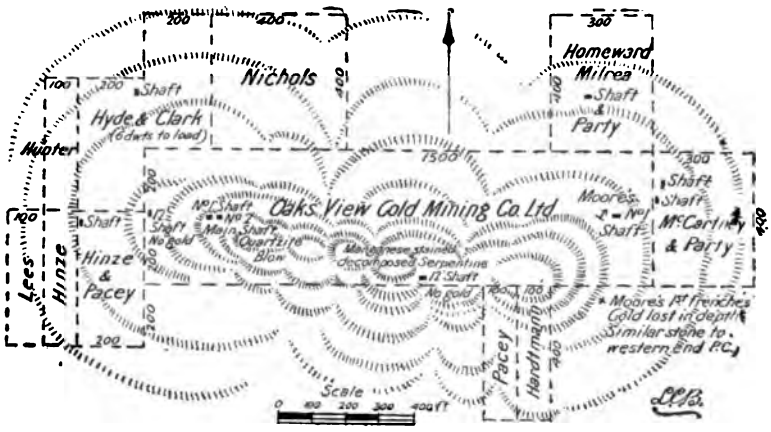
The hill itself (*see* Plate 1), which is about half a mile long and one third of a mile wide, rises only about 150 feet above the black soil swamps on the south, already spoken of. The low melon-hole country on the north and west gradually passes from the flat state into undulations, ridges, and hills, in which the rocks are chiefly quartzites and schists. Though quite isolated from these ridges the Oak View is not the only hill outstanding in the flats. The occurrence of quartzite, which is found intimately connected with the ore deposits, accounts for the resistance of the hill to denudation.

DISCOVERY AND HISTORY.

Mr. W. S. Thomason, in October, 1903, discovered gold by surfacing on Oaks View Hill, but did not proceed further in the matter till February, 1904, when he showed the place to a party of relatives and friends, with the result that payable gold was reported to the Rockhampton Warden in March of the same year. A reward claim (500 by 400 feet) and the usual ground (100 by 400 feet) per man were allotted in due course.

The returns of gold announced being somewhat sensational, a small rush took place. The ground on the east of the reward claim was taken up by Moore's party, who on discovering gold amalgamated with the original prospectors, the combined claims, known as the Oaks United, consisting of eleven men's ground, running east and west for 1,500 feet along the assumed line and north and south for 400 feet across it.

The Oaks United was, at the end of 1904, floated into a company (the Oaks View Gold Mining Company, Limited), with a nominal capital of £24,000, divided into 48,000 shares of 10s. each, of which 24,000 were issued fully paid up, and the remainder as paid up to 5s., this giving a working capital of £6,000.



ROUGH SKETCH PLAN OF OAKS VIEW CLAIMS.

Other claims (*see* Sketch Plan) had been taken up on the north, east, and west of the reward claims, but payable gold had, at the time of my visit, been found on none of them, with the possible exception of Hinze and Pacey's.

TREATMENT.

Treatment thus far (in the beginning of November, 1904) had consisted in dish-washing and cradling, generally without a preliminary dollying. The tailings at the well amount to five tons; 32 cwt. of the uncrushed stuff had been panned off for 92 oz. of gold, and 1 ton 12 cwt., taken from the tailings, had yielded a return of 12 oz. at Aldershot.

The gold saved by these methods enabled the prospectors to purchase a small Huntingdon mill and cyanide plant, which arrived on the field late in December, 1904; but at the time of my visit excavations were being made for a dam, there being no neighbouring stream of water. There are two shallow wells at the foot of the hill, but the water in them is believed to be entirely surface drainage, and quite insufficient to supply a battery.

OUTPUT.

The total gold saved by the above rough method amounted in December, 1904, to 327 oz. 4 dwt., valued at £3 14s. per oz.

According to reports in the Press, 27 tons of stone were crushed at the mine early in January, 1905, for a yield of 4 oz. 6 dwt. per ton.

This, it is presumed, included the tailings above referred to. It was noted that the battery had to close down after this run because of insufficiency of water.*

THE OAK VIEW GOLD MINING COMPANY.

The reward claim and those amalgamated with it, amounting to a total of 1,500 feet by 400 feet, take in practically the whole of the ridge top and the greater part of the northern slope of the hill.

On the very small amount of work done it is difficult to form any definitely favourable opinion. There is now only one small rich area of ground at the western end of the claim, though gold is known to exist, at least in small quantities, over most of the northern side of the hill, and payable gold has been reported from the eastern end of the claim.

WORKINGS.—The main workings (*see* Plate 2) are near the western end (*i.e.*, at the site of the original discovery), the No. 1 shaft lying about 200 feet from the centre of the western boundary. These include a few square yards of "surfacing," two shafts, and two or three shallow trenches. It is worthy of note that cuttings were made about twenty years ago by a prospector named Miller, who found gold within a chain of the present workings, but in insufficient quantities to pay.

The No. 1 shaft, 4 feet by 6 feet, has been sunk 18 feet in a decomposed gossany material (altered serpentine). The main shaft (No. 2) is 45 feet deep, and lies one chain to the east of No. 1 shaft, with which it is connected by an inclined stope.

The stope has a width of up to 30 feet, two drives opening to the northwards from it, one ten feet and one 20 feet in length. From the former an incline extends 50 feet in the same direction as the stope, which stope continues for about 20 feet below the main shaft. A drive to the north from the main shaft is 50 feet long.

Moore's No. 1 shaft, which, being without a windlass, was inaccessible to me, is at the eastern end of the amalgamated claims, about 60 yards north of the south-eastern corner peg and 18 chains east of the main workings. It is 25 feet deep, and from the bottom an underlie has been carried ten feet to the north-east.

The amount of prospecting done is very disappointing, though every excuse must be made for the holders, whose capital for exploitation had to be derived from the ground worked. No doubt when the mill begins to crush proper prospecting will be carried out.

---

* The total crushings for January are now to hand: 119 tons for 227 oz., or 1 oz. 18 dwt. 4 gr. per ton. The great difference between this and the result of the assays is caused, firstly, by the inclusion of rich "specimens" in the crushing; secondly, by the above mentioned patchy nature of the ground worked; and, thirdly, by the fact that the samples were taken from the surface of the heaps, which it is now presumed consisted chiefly of material last raised from the shafts.

Additional crushings are—March, 380 tons for 130 oz. 14 dwt., or 6 dwt. 21 gr. per ton; and April, 86 tons for 62 oz. 18 dwt., or 14 dwt. 15 gr. per ton.

ORE BODY.—The material from the surface to a depth of seven feet in No. 1 shaft, having been found to carry gold, it is intended to put the whole of it through the mill.

Gold was found from the surface to the bottom in sinking the main shaft, and the lower 15 feet of stuff is believed to average 3 dwt. to the ton. The five feet of ore at the bottom corresponds to that in the stope, but is not quite so pumiceous.

In the stope connecting the shafts an average of three or four feet of ore has been removed over the width stated; this consists of about two feet of earthy gossan, with patches of light-coloured serpentine under three feet of gossan, with indefinite, friable quartz leaderlets carrying gold, which is, however, invisible to the naked eye. The quartz is milky and hungry-looking, and includes irregular patches of the original serpentine. The ore seems to be thinning out on the south-eastern side of the stope, though towards the east there is at least seven feet of ore, veined with auriferous quartz.

The prospectors believe that the whole of the ore removed carries payable gold. In two spots, one near each shaft, exceedingly rich prospects can be obtained—in the one case (near No. 1 shaft) from a six-inch band, and in the other case (near the main shaft) from a patch about four feet across and nine inches thick, four feet above the floor, where the gold has been found in masses weighing as much as 2½ oz. Up to half an ounce to the dish was washed out in my presence. In the drive from the main shaft a seam of manganese-stained quartz one-sixteenth to three inches thick carried good gold, the solid metal being found in some places where the quartz cut out. The gold, even in these patches and veins, is very uncertain, and my samples, taken from the ore at grass, point to the general contents being much lower than has been thought.

The ore raised from the main shaft amounts to between 80 and 100 tons, and a surface sample from the heap yielded (Government Analyst):—

Gold—1 dwt. 19 gr. per ton.
Silver—Trace.

That raised from the No. 1 shaft amounts to about 25 tons. A surface sample yielded (Government Analyst):—

Gold—18 gr. per ton.
Silver—Trace.

Throughout the ore and overlying rock slickensides (often coated with a thin film of manganese dioxide) have been developed, and in the lower workings they appear to run to some extent parallel to the footwall. They are the most promising as well as the only sign of permanence observed.

The footwall of the auriferous ground is a light-coloured, clayey, decomposed serpentine. It is very irregular, often rising and falling a

foot or two, the fall in one place near the main shaft being as much as six feet. The country of the footwall is readily distinguished from the ore in the stope and deeper workings, but in the No. 1 shaft it has weathered into a substance very closely resembling the ore itself. The dip in the stope is to the north-east, the amount being only 20 degrees.

In Moore's No. 1 shaft 18 inches to two feet of auriferous stone is said to have been struck at 20 feet depth; and in an open-cut trench on the south-western side of it is a very ferruginous, gossany, decomposed serpentine, veined with auriferous quartz, and somewhat similar to the ore in the main workings.

The gold shown me from Moore's workings differs from that in the main workings, being heavier and platy (filling cracks in quartz), while that from the main working is all very finely granular.

The ore, speaking generally, is a soft, highly ferruginous, sometimes manganese-stained, cellular (almost pumiceous), irregularly quartz-veined, gossany material, the result of the alteration, presumably by uprising thermal solutions, of an original serpentine, as indicated by the occasional recognisable, though still altered, inclusions of that rock, and the unfailing presence of specks and flakes of a green chrome-bearing silicate.

About three chains south-east of the main shaft there is a big "blow" of quartz-veined quartzite, which appears to be replaced serpentine, the silica having in all probability been precipitated from the same solutions that altered the serpentine and deposited the gold. In this connection it is interesting to note the occurrence of thin films of hyalite (hydrous amorphous silica) on cracks in the country rock a short distance west of the main workings.

OTHER CLAIMS.

The ground outside the company's is really only being prospected; that is to say, nothing has yet been proved. Shafts are being sunk by the claimholders on the north, to catch at a depth the ore body being worked in the reward claim. East and west of the big claim outcrops, presumed to be on the line, are being tested.

On the unsecured ground to the south-east of Moore's claim considerably altered, ferruginous, quartz-veined, gossany serpentine outcrops, and several loose specimens yielding gold on crushing have been found, but no auriferous deposit has yet been located.

Hinze, Pacey, and Party.

This claim, 200 feet by 400 feet, adjoins the reward claim on the west.

A trench, about seven chains to the west-north-west of the company's main shaft, cut, on what was considered the line of strike, a promising four feet vein of quartz dipping 70 degrees to north-north-

east. Specks of gold can occasionally be seen in this quartz, and the fact that they are enclosed in the solid is a very favourable sign. A sample of the stone assayed (Government Analyst):—

Gold—11dwt. 4 gr. per ton.
Silver—3 dwt. 19 gr. per ton.

A shaft adjacent to this trench had been sunk 45 feet, and a crosscut to the reef was being opened in country very similar to that in the reward claim. In sinking the shaft several boulders of magnesite, coloured with the faintest tinge of green, were found, the green colour being very probably due to traces of nickel silicate (Noumeite).

Hyde, Clark, and Party.

This claim takes in ground both on the west and on the north of the reward claim, consisting of two claims, each 200 feet by 400 feet.

The shaft, 55 feet deep, lies eight chains north-north-west of the prospectors' workings. It opened on a bed of quartzite three feet thick, passing out of it at 50 feet depth, where the thickness is six feet, the dip being about 45 degrees to the north. Below the quartzite is a soft, gossany, quartz-veined material, like that in the reward workings, but carrying only a few colours of gold, so far.

Nichols and Party.

Nichols' claim adjoins the reward claim on the north, and Hyde and Clark's on the east.

A shaft, four chains from the main workings, was being sunk in soft, decomposed serpentine, the changes in which appear to dip west-north-westwards at an inclination of 1 in 6. This may be only a local dip, that in the reward claim being 1 in 2 to the north-north-east.

The shaft was 35 feet deep when seen, and it was hoped to strike the auriferous formation of the reward claim within 150 feet from the surface, to which depth the party is prepared to sink.

Of course, it is impossible to say that the dip of the footwall in the reward claim will remain constant, but the sinking of this shaft is justifiable as a means of prospecting the ground.

McCartney, Rea, and Watson ("Morning Star").

This claim, 200 feet by 400 feet in area, is at the eastern end of the company's claims.

A shaft is now being sunk 1½ chains from the north-western corner peg in the expectation of striking, within 50 feet, a quartz reef outcropping to the south; the country is iron-stained, altered serpentine, carrying flakes of green chrome-bearing silicate and bunches of slightly pyritous quartz.

Another shaft, 30 feet deep, a chain south-south-west of the above, struck, at seven feet depth, a reef 6 to 15 inches thick, dipping 45

degrees to the north. Beneath this is eight feet thickness of country replaced to a greater or less extent by quartz, which, though promising in appearance, yielded (Government Analyst) on sampling only traces of gold and silver.

Homeward, Milrea, and Party ("Last Chance").

The claim, 300 by 400 feet in area, lies on the north of the company's ground at the eastern end.

Quartz-bearing country (with reported traces of gold) dipping 1 in 2 horizontally to the north-north-east, had been just struck at the bottom of a 36 feet shaft, the material between 32 and 36 feet depths agreeing in physical characteristics almost exactly with the ore in the reward claim.

Pacey's and Hardtmann's.

These two claims had lately been pegged out on the southern side of Moore's old claim, though it is generally agreed that gold does not occur on the southern slopes of the hill, where these claims lie.

Hunter's.

Hunter's claim, 100 by 400 feet, is on the western side of Hyde and Clark's.

Fragments of manganese-stained quartz lie scattered over the surface for some three chains, commencing about a chain north of the line of strike of the reef in Hinze and Pacey's claim. One outcrop appears to run north-westwards; but as only one or two small trenches have been opened, and as they show only decomposed serpentine, nothing definite can be seen. It is, nevertheless, inferred that this reef is a faulted portion of that in the latter claim.

23rd January, 1905.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY REPORT
No. 200.

The Central Queensland (Dawson-Mackenzie) Coal Measures.

THEIR CONTINUATION TOWARDS THE MACKAY AND NEBO DISTRICTS.

(WITH MAP.)

BY

WALTER E. CAMERON, B.A. (Cantab.)
ASSISTANT GOVERNMENT GEOLOGIST.

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CONTENTS.

THE CENTRAL QUEENSLAND (DAWSON-MACKENZIE) COAL MEASURES.

THEIR CONTINUATION TOWARDS THE MACKAY AND NEBO DISTRICTS.

I.—INTRODUCTION.

The field work for this report occupied the months of May, June, and July of last year. It took the form of a rapid geological reconnaisance of the country drained by the Isaacs River and Funnel Creek and their tributaries, its object being to trace the continuation of the coal measures, at present being prospected along the Central District railway line, northwards, towards those known to exist in the Nebo and Mackay districts, and to map the relations between the two.

The coal beds of the Nebo district had been previously referred to in geological reports both by R. L. Jack* and A. Gibb Maitland†, and their identity with those along the Central line inferred on palaeontological grounds, but the intervening country had never been examined by an officer of the Survey, and the mapping of the beds on the Colony Geological Map was only a guess at the relation between the two districts.

The general geological features of the Permo-Carboniferous coal measures of the Central District had not been in any way elucidated until the district along the Central line was mapped and described by Mr. Dunstan in 1901. Mr. Dunstan's examination extended in a north and south direction along the eastern boundary of the coal measures from a point on the Dawson River some 80 miles south of the line northwards across the line, and for another 60 miles up the Mackenzie River to near its junction with the Isaacs.

In a westerly direction the beds were mapped along the Central Railway for a distance of about 80 miles from their eastermost outcrops.

The results of this survey were published in a report entitled "The Geology of the Dawson River, with special reference to the occurrence of Anthracite Coal," published as No. 155 of the Geological Survey Publications. The map accompanying the report shows the extent of the area examined and the general disposition of the beds.

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* Geological Features of the Mackay District. R. L. Jack. Brisb.: By Auth., 1887. (G.S.Q., P. No. 39.)

† Geological Observations at the heads of the Isaacs, Suttor, and Bowen Rivers. A.G.M. Brisb.: By Auth., 1889. (G.S.Q., P. No. 54.)

In his report on the Mackay district Mr. Jack made the first reference to the discovery of coal of a semi-anthracitic character in Queensland, and published an analysis showing its percentage composition. The analysis is given later on in this report. The coal came from Walker's Creek, about 60 miles south-west of the port of Mackay, and about 10 miles due west of Nebo. The work done by the writer shows that the beds containing this coal are a continuation of those in which high-steaming coals were subsequently found on the Dawson, and traced by Mr. Dunstan to the junction of the Isaacs and Mackenzie River, and consequently shows that the coal resources of Central Queensland are continuous for many miles north of the Mackenzie River. It has also served to define the eastern boundaries of the coal measures, with some attempt at accuracy, for some distance further north than formerly, besides throwing additional light on the general disposition of the beds.

Since 1901, when the first coal seam was discovered in the Dawson-Mackenzie Valley, about 40 miles south of the Central line, prospecting for coal has been carried on by several companies, with the object of locating seams along the railway line. This has resulted in the finding of coal at several places in close proximity to the line, notably at Wallaroo, about 78 miles west of Rockhampton, and also near Blackwater, 108 miles from Rockhampton. The high steaming qualities of these coals, as shown by several tests made by the engineers of H.M. warships, has led to the hope that in the near future Central Queensland will become a large exporter of steam coal.

The fact that coals of high steaming character have been found at such widely separated points (Walker Creek being some 220 miles from the coal beds on the Dawson), and that the beds are continuous between the two places, gives a promising forecast for the great resources of this portion of Queensland in high-class steaming coal.

The accompanying map shows, in as much detail as the time occupied in the journey would allow, the continuation of the lower beds of the coal measures. These outcrop along the eastern margin of the field and were traced from near the junction of the Isaacs and Mackenzie Rivers to the head waters of Cooper Creek, near Mount Britten Goldfield, a distance of about 120 miles. The mapping was greatly facilitated, and rendered more accurate, by the use of an advance copy of a sheet of the four miles maps of unsettled districts, at present being issued by the Lands Department, which was then being prepared for issue, and was kindly supplied by the department. A few additions to the topographical detail have been made wherever they were observed, especially in the matter of roads which have sprung into existence since the survey of the country. A few corrections have also been made in place names where they have recently been changed.

II.—GENERAL GEOLOGY OF THE COAL MEASURES OF CENTRAL QUEENSLAND.

The coal-bearing beds at the head of the Isaacs, and those examined by Mr. Dunstan along the Central Railway line, are shown by the assemblage of fossils found in them to be both of Permo-Carboniferous age, and thus of the same age as the coal measures of Newcastle, Bulli, and Lithgow, in New South Wales. They are thus older than the coal measures hitherto worked in Queensland at Ipswich and Burrum, which belong to the Trias-Jura system. They are, however, of the same age as the coal beds of the Bowen River, lying still further to the north. These latter beds were tested by Government bores as long ago as 1879, and shown to contain several valuable seams of coal. They were reported on in the same year by R. L. Jack*, late Government Geologist; and from them the whole of the coal beds of Central Queensland, from the Bowen River on the north to the heads of the Dawson on the south, and for a width of about 120 miles in an east and west direction, have long been known as the Bowen River beds. They are shown on the Colony Geological Map underlying an area of about 37,000 square miles, occupying the greater portion of the valleys of the Dawson, Mackenzie, and Isaacs Rivers. Their eastern margin has been roughly mapped in by Mr. Dunstan and the author along the western flanks of the ranges which hedge in the valleys of these rivers from the lower coastal country. Their western and southern boundaries, however, have only been roughly guessed at. Along their eastern margin they are underlain by considerably altered quartzites, slates, and schists, which have proved fossiliferous in a few areas close to the Central line, and which have there been referred to the Gympie formation. North of the Isaacs-Mackenzie junction similar altered sedimentary rocks are found to the east of the coal measures, but so far they have not proved fossiliferous. Their highly-developed cleavages and frequent intrusions of igneous rocks stand out in marked contrast to the comparatively unaltered character of the beds in which the coal measures lie. As the Nebo district is approached the intrusive plutonic rocks become more prevalent, till they culminate in the Eungella Ranges, at the back of Mackay, as a belt of granite and diorite some 20 miles in width.

Mr. Dunstan, in his report, divided the Bowen River beds in the Central district into an Upper and a Lower Formation, with an unconformity between the two. The Lower Formation he divides into four series, all conformable with each other, but distinguished by palaeontological features from each other. They are as follow:—

1. Upper Freshwater Series, with glossopteris and other plant remains.
2. Upper Marine Series, with marine fossils.
3. Lower Freshwater Series, with glossopteris.
4. Lower Marine Series, with marine fossils.

* On the Bowen River Coal Fields. R.L.J. Brisb.: By Auth., 1879. (G.S.Q., P. No. 4.)

The Lower Marine Series thus forms the lowest division of the Lower Bowen Formation, as developed in the Central District. In the Bowen River district, where the Permo-Carboniferous coal measures were first examined in detail, Mr. Jack divided the Bowen River beds into a Lower, Middle, and Upper Formation, as follow:—

1. Upper Formation (Freshwater coal-bearing series).
2. Middle Formation (Marine beds, with productive crinoid, &c.)
3. Lower Formation (conglomerates, volcanic agglomerates, unfossiliferous sandstones, with interbedded porphyries and basalts.

The Lower Marine Series of Mr. Dunstan was traced by the writer from the northernmost point of Mr. Dunstan's map as far as the Yatton Goldfield, and was found again over a length of some 10 miles near Mount Britten and Eungella. It was traced by Maitland from here to R. L. Jack's Middle or Marine Formation on the Bowen River.* The Lower Freshwater series of the Central district was found overlying the marine beds along the Isaacs Valley to near its source, and is no doubt continuous with Jack's Upper or Freshwater Formation. The new classification proposed by Mr. Dunstan accordingly places Mr. Jack's Middle Formation (Marine) on the same horizon as the Lower Marine series of the Central District, and his Upper or Freshwater Formation on the same horizon as the Lower Freshwater series, including them both in the Lower Formation, and extending that formation up to include conformably overlying Marine and Freshwater series above. Succeeding this Lower Formation of alternating Marine and freshwater series unconformably, are the beds of the Upper Formation, which have as yet been found only over small areas in the Clermont coal fields and at Tolmie's, on the Central line.

The beds of the Lower Bowen Formation over the greater portion of the Dawson-Mackenzie Valley are overlain by newer Lower Cretaceous and recent formations. The lowest beds of the formation—the Lower Marine series—come to the surface along the eastern border of the Dawson-Mackenzie Valley as an outcrop of sandstones and limestones, some four miles in width, running in a north and south direction along the western flanks of the range, which hems in the eastern side of the valley. This outcrop was traced by Mr. Dunstan from a point about 40 miles south of the Central line northward to the Isaacs-Mackenzie Junction. The breadth of the outcrop diminishes here to about one and a-half miles. Further west the Lower Marine series is overlain by the coal-bearing beds of the Lower Freshwater series, which are assumed to underlie the greater portion of the Dawson-Mackenzie Valley, where not overlain by the horizontal sandstones and conglomerate of Upper Cretaceous age, which form extensive tablelands on the higher ground between the main streams.

* See map accompanying Annual Report of Geological Survey for 1889. (G.S.Q., P. No. 58.)

III.—THE BOWEN RIVER BEDS BETWEEN THE ISAACS-MACKENZIE JUNCTION AND THE NEBO DISTRICT.

The tracing northward of the eastern boundary of the coal measures was began by ascending the coast range from the head waters of the Styx River. The tributary creeks of the Styx, under the range, show in their banks beds of hard blue slate, which lie with gently undulating inclinations, and show marked vertical cleavages, the latter striking generally north and south. Overlying them on the higher ground between the creek beds, and up the eastern face of the range, are coarser schists and quartzites, the former showing the same north and south striking vertical cleavages, and giving the impression, on merely surface outcrops, that vertically dipping beds are being passed over. These altered sedimentary rocks are mapped on the Geological Colony Map as belonging to the Gympie Formation, having afforded a few marine fossils of probably that age from the neighbourhood of Mount Brunswick and Granite Creek in this district.

As the range is ascended granite and porphyry is met with, and passed over till the level ground bordering the river on the other side is reached. Here blue shales containing Glossopteris, and evidently belonging to the Lower Freshwater series of the coal measures, are met with along Bottle Creek, just above its junction with the Mackenzie, and below the junction of the latter with the Isaacs. The massive crystalline rocks forming the main massif of the range extend as a spur from the main range for about a mile further south. This spur heads off the waters of Apis Creek, and against it the Mackenzie River is deflected in its course from a north-easterly to an almost southerly direction. From this point northward the plutonic rocks apparently form the backbone of the coastal ranges, which bound the eastern limits of the valley of the Isaacs River, extending as a narrow belt to near the head of the Connors River, where they spread out over a width of about 20 miles in the high ranges to the east and north of Nebo and Mount Britten.

Flanking the plutonic crystalline rocks on the western side of the range near the Isaacs-Mackenzie junction indurated conglomerates, with interbedded rhyolites and tuffs, are found along the bed of Clive Creek. Four miles further north on Bora Creek are gneisses and schists with the same north and south strike and steep westerly dip. Lying uncomformably on these altered rocks and dipping at angles of up to 30 degrees away from them, the fossiliferous limestones and sandstones of the Lower Marine series are exposed in the creek bed under Mount Bora. The limestones are white and crystalline, and are made up almost entirely of shells of productus, spirifer, and crinoid stems. The sandstones are soft and weather easily, affording few exposures even in the banks of the creeks. The road from Clive station, on Clive Creek, follows the left bank of the Isaacs River along a wide alluvial terrace bounded on the north-east by thick brigalow

scrub. Near the head of Yatton Creek, about two miles south of the old goldfield, the limestones of the lower marine series were again met with.

They form here a series of low scrubby hills, the varied character of the vegetation on the limestones standing out in marked contrast to that of the open forest timber of box and ironbark found on the less fertile ridges of igneous and metamorphic rocks lying to the north and east. They contain here the same abundant marine* shells and crinoid stems as are found further south. The older rocks of the goldfield and along the heads of Lotus Creek consist mainly of diorites and porphyries, with some outcrops of slate and gneiss. About three miles west of these hills, on the Yatton to Croydon road, ferruginous shales and sandstone, showing fern impressions and apparently of the Lower Freshwater beds, were met with two miles south of Yatton station. Thin even-bedded shales and sandstones with gentle westerly dips are found overlying crumpled and twisted slates, showing marked cleavages perpendicular to the bedding. The latter are evidently of much older date than the former, which were laid down on them since their cleavage was imposed upon them. Otherwise there is little to show that the one series is not conformable with the other.

Similar shales and sandstones are found 18 miles further north, near Lotus Creek station, where they again overlie quartzites and greywackes of the older beds.

From Lotus Creek northward the junction of the Bowen River beds with the older underlying rocks was nowhere observed, the extension of the coal measures being obscured for 60 miles further north, first by the alluvium of the Connors River and Funnel Creek and a wide area of Upper Cretaceous sandstone lying between Funnel Creek and the Isaacs River, and further north by a large area of basalt country forming the open rolling country of Oxford Downs and Fort Cooper stations. The marine sandstones of the Lower Marine beds were again picked up on the road from Nebo to Mount Britten Goldfield, where they are again found with the same regular north-north-westerly strike and south-westerly dip, on the western side of the Eungella and Mount Britten range. They show here abundant spirifer, productus, and other marine fossils of Lower Bowen type.

Soft sandstone and clay shales showing frequent impressions of *Glossopteris* and *Sphenopteris* (?) were found along the Isaacs River above Leichhardt Downs and along its tributaries—Phillips Creek,

* Mr. Jack (in his "Geology of Queensland and New Guinea," p. 95) has recorded the following fossils from these beds, which he accordingly refers to the Gympie Formation. The fossils are, however, common to the Marine Formation of the Bowen River Beds, as he shows on page 160 of the same work, and I have no doubt from the stratigraphical relation of the Yatton beds that they belong to that Formation. The fossils are—*Spirifera lata*, McCoy; *Spirifera Stokesii*; *Martinia Darwinii*; *Productus subquadratus*; *Productus*, sp. ind.; *Aviculopecten limæformis*; and *Eurydesma*, sp. ind.

North Creek, and Cherwell Creek. These beds no doubt belong to the Lower Freshwater coal-bearing horizon. They lie in gentle undulations, and afford few exposures except along the upper courses of the creeks. They have been denuded down to a peneplain, showing only slight elevations above the general base level of the river, their weathering affording grassy plains and dense brigalow scrubs over wide areas on each side of the river. Between the river and Funnel Creek is a stretch of sandy country drained by Devlin or Rockwood Creek, some 25 miles wide, and stretching 40 miles N.N.W. from its junction with the Isaacs. The few outcrops afforded by this country show horizontal siliceous sandstones, which, in lithological character and general horizontality of bedding, show such great resemblance to the desert sandstones of Upper Cretaceous age, found generally over Queensland that they have been mapped as belonging to that formation.

Several small outliers of the same formation occur to the east of Funnel Creek, while rocks of apparently the same age overlie the lower Permo-Carboniferous rocks over a wide area to the north-west, in the higher ground at the sources of the Isaacs River and Cherwell Creek.

Sandstones and shales containing fern impressions of Permo-Carboniferous facies and showing several outcrops of coal cover a large area along Harvybrandt, Carborough, Walker, Kemmis, and Bee Creeks, all of which drain east and south into Cooper and Funnel Creeks. Around Nebo itself they are overlain along Cooper and Nebo Creek by a sheet of basalt some 70 square miles in area, forming a wide extent of open downs country covered with a rich black soil.

Evidences of former volcanic action in this district are also given by the cappings of trachyte found overlying the heights of the ranges near Mount Britten and at scattered points further south on Mount Donaldson, Mount Landsborough, and the Peak.

A description of the points at which coal has been reported will be reserved till the general geology of the country about Mackay, Nebo, and Mount Britten has been discussed.

IV.—GENERAL GEOLOGY OF THE MACKAY AND NEBO DISTRICTS.

The road from Mackay to the Nebo district passes over low-lying, undulating country, till it reaches the foot of the range which divides the coastal plains from the elevated tablelands drained by the head-waters of the Isaacs and Bowen Rivers. The low-lying country is underlain for the most part by more or less horizontally disposed beds of sandstone and shale, with here and there outcrops of coal and coaly strata. These coal-bearing sedimentary rocks have been traced along the coast, skirting the foot of the range, for about 50 miles to the north and south of Mackay, and with an average breadth of about 15 miles from the coast. On the west they are flanked by the belt of

eruptive rocks which constitute the main mass of the range, and form a strip of rough mountainous country some 20 miles in width. This belt of eruptive rocks separates the coal measures of the coast from those at the heads of the Bowen and Isaac Rivers. The coastal beds were early referred by Mr. Jack to his Lower Bowen Formation, on account of their lithological resemblance to them.*

In 1889 they were examined and mapped in some detail for about 30 miles north and south of Mackay by Mr. Maitland.† Remains of the plants *Phyllotheca* and *Glossopteris* were discovered by him near the head of Sandy Creek.

The district was also visited by Mr. Dunstan‡ in 1901, for the purpose of reporting on coal seams at Hazeldean, at the top of the range, and by the writer‖ in 1903, for the purpose of reporting on coal seams found on Black Rock Creek, about 20 miles north of Mackay. Up to the present no coal seams of workable thickness and quality have been found in these beds. The beds are, indeed, so much disturbed by contemporaneous flows of basalt and by subsequent intrusions of granite and other plutonic rocks that they do not hold out very great prospects of ever affording very valuable seams of coal. Their geological age is still a matter of doubt. They have, unlike the Permo-Carboniferous rocks along the Isaacs and Bowen Rivers, been considerably disturbed by intrusions of granite and felsite near the Main Range and at various points over the coastal plain, having apparently been laid down before the intrusion of these plutonic rocks took place. The coal measures west of the range, on the other hand, show no sign of such intrusion, and were apparently laid down after the subsidence of the eruptive agencies noticeable along the coast. These latter beds consequently appear to be of somewhat more recent date than the beds found below the range. The effect of the intrusion of the granite on the sedimentary rocks east of the range is well seen as the range is ascended between Eaton and Hazeldean.

As the range is approached, hills of granite begin to make their appearance. The road sections up the range show outcrops of granite alternating with altered sandstones and grits, which are found right to the top, some 1,000 feet above. Judging from their closely-set joint planes and great variations in dip and strike, these beds have been subjected to considerable movement and pressure. They contain

* On the Geological Features of the Mackay District. R.L.J. Brisb.: By Auth., 1887. (G.S.Q., P. No. 39.)

† On the Geological Features and Mineral Resources of the Mackay District. A.G.M. Brisb.: By Auth., 1889. (G.S.Q., P. No. 53.)

‡ Geological Features of Hazeldean, &c. B.D. Brisb.: By Auth., 1901. (G.S.Q., P. No. 164.)

‖ Geology of Mackay and Bowen Districts (Addition to the). W.E.C. Brisb.: By Auth., 1903. (G.S.Q., P. No. 181.)

small coal seams, and have afforded plant remains such as *Phyllotheca* and *Glossopteris*, so that they apparently belong to the same coal-bearing series as the beds found along the coastal plain, their elevated position and altered character being accounted for by the movements to which they have been subjected by the intrusion of the granite mass. Intrusive masses of granite and diorite are also shown on Mr. Maitland's map accompanying his report on the district, at Scrubby Mountain, at the head of Bell's Creek, at Mount Vince (near Walkerston), Mount Catherine (near Black Rock Creek), and many other points over the coastal plain. In many cases these intrusive plutonic rocks have disturbed the general horizontal position of the coal measures, and in some cases have metamorphosed the rocks and their accompanying coal beds in a marked degree.

As the road passes south-westward from the summit of the range, rough ridges of granite are passed over for the next 20 miles, till the Pisgah Range, forming the divide between Denison Creek and Cooper Creek water, is reached. Immediately west of this the granite gives place to a belt of highly-altered sedimentary rocks, which flank the western side of the granite for some 90 miles further north. Along the junction line of these altered sedimentary rocks and the plutonic rocks are the goldfields of Mount Britten, Eungella, and Normanby. South of the Mackay-Fort Cooper road the western edge of the granite is obscured by the basaltic and alluvial soils of Oxford Downs and Fort Cooper. The geological age of the slates and schists has not been determined, no palæontological evidence being as yet forthcoming. They are, however, from their position and highly-altered character, evidently much older than the Permo-Carboniferous coal-bearing rocks which succeed them further west. Two detached outliers of the same rocks occur within the area covered by the Permo-Carboniferous beds further west. The one lies about 20 miles south-west of Nebo, and occupies an area of about 100 square miles, in which lie the copper deposits of Mount Orange and Mount Flora. The second is situated about 14 miles due west of Mount Britten, and is much smaller. In it are the now deserted copper deposits of Mount Gotthardt.

The lower Bowen Beds succeed the granitic and altered rocks to the west. The lowest members of the series are found in the neighbourhood of Mount Britten, where marine sandstone carrying abundant remains of *Spirifer*, *Productus*, *Martiniopsis*, and crinoid stems outcrop over a breadth of some 2 miles. These beds strike about north-north-west, and dip to the west-south-west at angles of from 30 degrees to 60 degrees. When traced to the south they cut out against the underlying slates and schists, the softer sandstones and shales of the overlying Freshwater Series being thus brought directly into contact with the older metamorphic rocks. They were traced north by the writer as far as Hazelwood Creek, near Eungella Station, and on Mr. Maitland's map (*loc. cit.*) they are shown to form a continuous outcrop about 2 miles in width from here to where they were first

observed in 1879 on the Bowen River by Mr. Jack. Mr. Maitland maps the rocks on which these marine beds lie about Nebo and Mount Britten as of Mr. Jack's Lower Bowen Series. My own observations between Mount Britten and Eungella led me to conclude that they are of much older date and the mapping has been altered accordingly. There is in fact a distinct unconformity between the slates and schists of Mount Britten and Eungella and the overlying Lower Marine Series.

The country to the west and south of these beds is underlain by gently undulating sandstones and shales of the coal-bearing Lower Freshwater Series, the outcrops of coal on which are described below.

V.—THE COAL OUTCROPS OF THE NEBO DISTRICT.

Coal seams have been known to exist in the Nebo district for the last thirty years, and Mr. Jack mentions in his report (*opus cit.*, p. 2) that as long ago as 1878 two prospecting shafts were sunk on coal in the bed of Bee Creek, above its junction with Hail Creek. Shafts were also sunk in coal in the bed of Walker's Creek, about 2 miles above its junction with Carborough Creek, and about 10 miles due west of Nebo. These shafts have long since been filled in with sand washed down by the stream, but the top portion of the seam can still be seen in the bed of Walker's Creek, about a mile above the junction. Mr. Jack gave the following section of coal strata in the bed of the creek :—

	Ft.	in.
Sandy shale, with lines of very large ferrugino, calcareous nodules in upper part and lines of ironstone nodules in lower part (*Glossopteris* abundant; also a specimen of *Pecopteris*)	13	2
Laminated fireclay (sometimes sandy)	2	0
Compact fireclay (Phyllotheca abundant)	0	8
Dark shale	0	2
Coal	3	5
Gray shale	0	1½
Coal	0	2
Hard red ironstone	0	3
Coal (bottom not seen)	0	9

A specimen analysed had a specific gravity of 1.38, and contained—

Water	2.99
Volatile hydrocarbons	6.71
Fixed carbon (from hard coke)	84.74
Ash (pale brown)	3.56
	100

Mr. Jack remarks :—" The coal of Walker's Creek is an anthracite containing a higher percentage of fixed carbon and a lower percentage of earthy impurities than any coal of its class known in Queensland or New South Wales. It approaches in composition some of the best anthracite of Wales and Pennsylvania."

No attempt has been made to develop these coals. Their distance from a port (the nearest point of the coalfields being some 60 miles from Mackay) and the difficulties of transport across the coastal ranges between Nebo and Eton will probably prevent their being brought into requisition for the present. Judging from the above analysis, their qualities as good steaming coal seem likely to be highly satisfactory.

The fuel ratio (*i.e.*, the ratio between the fixed carbon and the volatile hydrocarbons) of the above sample is 9.73. This brings the coal within the class often referred to as semi-anthracitic. The uses of such coals are practically the same as those of anthracite, and they are generally known in the trade by that name. In addition to their high-steaming qualities, their value as fuel is enhanced by the fact that they are hard coals, standing rough handling, and removal to long distances without making an excessive amount of slack. They are also not subject to spontaneous combustion under ordinary conditions. They are thus eminently suitable for export to distant localities, and can be stored without rapid deterioration. In addition to this, they give a smokeless fuel.

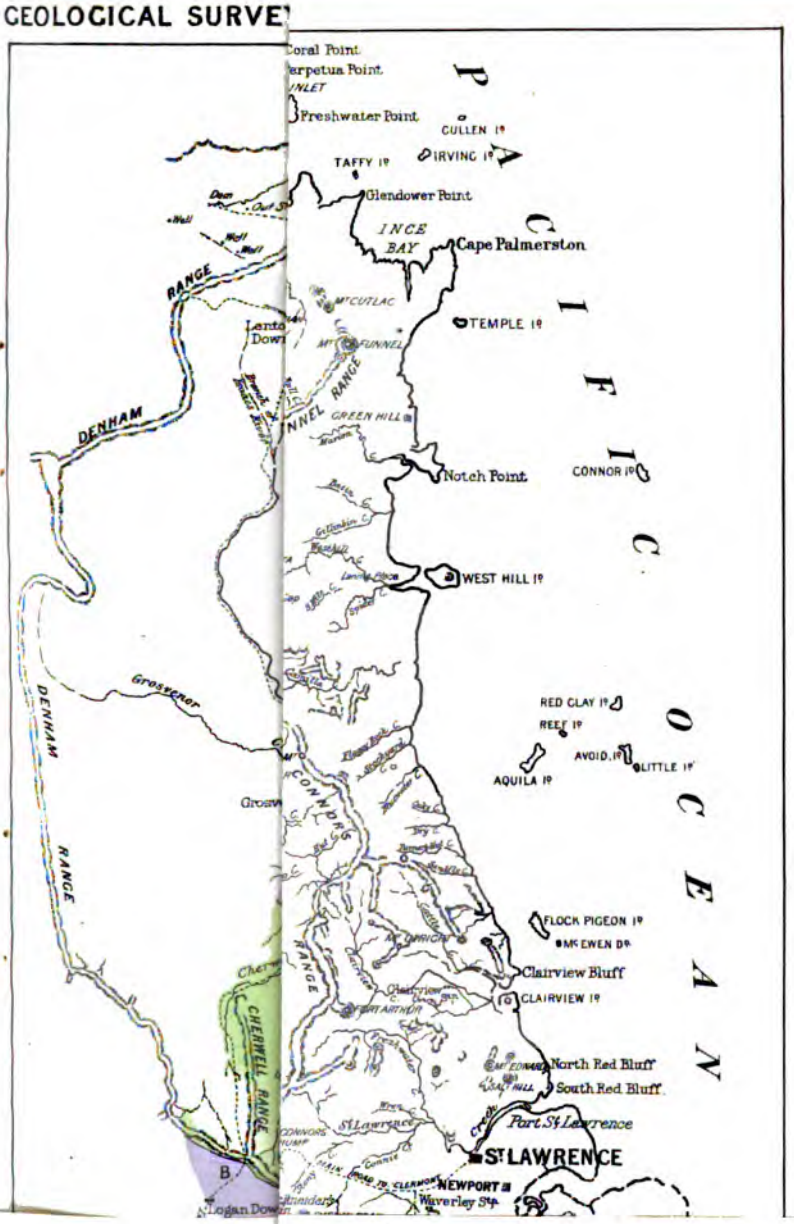
The most favourable area for prospecting lies between Cooper Creek on the east and the Carborough Range on the west, and between Harrybrandt Creek on the south and the head of Hail Creek on the north. The generally slightly inclined character of the beds over this area augurs well for the occurrence of coal at easily worked depths over wide areas. Besides the before-mentioned coal outcrops on Bee and Walker Creeks, coal was observed along the eastern edges of this area as far north as the head of Cooper Creek, at a point about 4 miles due west of Mount Britten and as far south as a point about 3 miles due south of Oxford Downs Station.

Coal crops were also reported to have been seen during the 1902 drought from the head of Bee Creek, near Elphinstone Station, and from near the crossing of the Mackay to Clermont road, about 20 miles further south. These crops were not visited, as they were reported to be covered with sand, and their location and examination would have entailed considerable loss of time.

The level character of the country and general horizontality of the beds do not lend themselves readily to prospecting, so that, in order to give hope of success in locating seams boring will probably have to be freely resorted to; but before anything of the kind is attempted a geological survey of the area in more detail than was considered advisable at the time of my visit should be undertaken.

Geological Survey Office, Brisbane, 6th March, 1905.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.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MT FUNNEL
FUNNEL RANGE
GREEN HILL
DENHAM RANGE
Notch Point
CONNOR I.
WEST HILL I.
Grosvenor
RED CLAY I.
REEF I.
AVOID I.
LITTLE I.
AQUILA I.
CONNORS RANGE
FLOCK PIGEON I.
McEWEN D.
Clairview Bluff
CLAIRVIEW I.
CHERWELL RANGE
North Red Bluff
South Red Bluff
Port St Lawrence
ST LAWRENCE
NEWPORT
Waverley Sta.
Logan Downs
PACIFIC OCEAN

Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensl

PUBLICATION No. 20.

BLACK RIDGE, CLERM

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WITH

APPENDICES ON THE STATE OF THE MINERAL I
IN THE CLERMONT DISTRICT DURING 19

WITH 4 MAPS, 12 FIGURES, AND 15 PLATES

II.—Supplementary Notes.

WITH 7 FIGURES AND 6 PLATES.

By LIONEL C. BALL, B.
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BRISBANE:
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V.—MICLERE.

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Preliminary Report on the Black Ridge

(CLERMONT).

I.—INTRODUCTION.†

1. LOCATION AND EXTENT.

The Springs Goldfield Extension was proclaimed, in the "Government Gazette" of 1888, to have an area of 12½ square miles. The field is bounded on the north by the scarcely to be distinguished divide (the Drummond Range) between the Burdekin and Mackenzie waters. The Springs Hotel, in the centre of the proclaimed field, lies 11 miles west by north of Clermont, with which it is connected by a first-class road.

A vast amount of work has been done on this old field on lines running north-west and east from the hotel. East of the hotel, work, except that of a few dryblowers, has practically ceased; but to the north-west operations are still being carried on upon a small scale in a few claims. In the extreme north-west are the shallow workings of the Black Ridge, the deeper workings on the same runs being outside the goldfield.

Operations are also going on at the Miclere, nine miles north-north-west of the Springs; at McMaster's, four miles west; at Black Johnson's, two miles north of McMaster's; and at Schnuffler's Dam, 1½ miles west-south-west of Top Camp (McMaster's).

The estimated population at the various centres in 1904 was as follows:—Black Ridge, 250 men; Miclere, 60 men; McMaster's, 25 men; Hurley's, 16 men; Cockatoo Dam, 10 men; Schnuffler's, 6 men; Black Johnson's, 4 men; Scrubby Dam, none; intervening country, a small number.

2. GENERAL FUTURE PROSPECTS.

The Black Ridge and the country northwards is at present the mainstay of mining in the district.

The plateau between Black Ridge, Miclere, and McMaster's is covered almost entirely with basalt or basalt soil, most of which is underlaid by coal measures and auriferous deposits, for such dip under it at the three localities mentioned. The area of the triangle referred to is 16 square miles.

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† My stay in the Clermont District extended from the beginning of July to the middle of August, 1904, the greater part of the time being spent in the Springs-Black Ridge vicinity. The delay in publication has been due to more urgent departmental matters requiring my attention.

My acknowledgments are due to Messrs. Bacon, Douglas, Ford, Hopkins, Illedge, Jones, McDougall, Noonan, Small, and Young, and to every claimholder approached, for having, without exception, given me every assistance.

It is, however, probable that the auriferous ground will extend to the south, beneath the Blair Athol Collieries and Hurley's Diggings, to the Venus, where similar ground is now being tested.

It is possible that, owing to the storage of water beneath the basalt, the individual miner will sooner or later have to give up the attempt to reach the auriferous ground beneath; but by that time mining companies will have entered the field, equipped to overcome the water in sinking and to work the auriferous gravels on a much more systematic and profitable basis than has yet been done. The fact that the gold-bearing stratum itself is comparatively dry is greatly in its favour.

It will be first necessary to sink bore-holes to test the ground, not only in the Black Ridge-McMaster-Miclere triangle, already referred to, but also on the Blair Athol Coalfield, where the occurrence of thick seams of high-class coal (the ash of which has been proved to be auriferous) above the auriferous beds and capable of being worked from the same shafts, and by perhaps the same methods, would give a boundless supply of power for all mining operations on any scale whatever.

The workings west of the Venus Hotel, in cement ground identical with that at the Black Ridge, prove the continuation of the "cement" in a southerly direction.

3. TREATMENT AND OUTPUT.

Treatment.—Taking the fields as a whole, the material treated consists of (1) surface soil and detritus, (2) ordinary gravels, and (3) conglomerate.

1. The *surface material* is almost invariably dry-blown or dry-jiggered (the finest screen in the dry-jigger being thirty to an inch). It very seldom requires a preliminary drying by fire, owing to its exposure to the tropical sun.

2. The *gravels* are "puddled," whether their nature be clayey or not. The puddlers or puddling machines are erected adjacent to a constant supply of water (a permanent well), and the material is carted to them. There are two puddlers (Murphy's and Walker's) midway between the Black Ridge and the Springs. (Plate 1.)

Treatment, including cartage from Black Ridge to the puddlers (a distance of about a mile), is given as 5s. per ton. The miners, however, supply their own men to do the sluicing, the owner simply supplying plant, power, and water for puddling.

During 1895, 1896, and 1897, 20,000 loads were puddled for an average of 11 dwt. (*Fide* Chas. Young, Esq.).

In exceptional cases, as at McMaster's, the "fines" are washed in a wet-jigger.

Photo., L.C.B. **MURPHY'S PUDDLER, THE SPRINGS.** **Plate 1.**

SHOWING CIRCULAR PUDDLING TROUGH, RAKES, ETC., AND ALSO SLUICE-BOX.

3. The *conglomerate*, when not "cemented" (hard), is also sent to the puddlers, but as a rule its indurated condition necessitates its going to the stamper battery, where it is put through the same treatment as ordinary reef quartz.

Two attempts have been made to carry on crushing at Cement Hill (Springs). A crushing mill is reported to have been erected in 1887, but was dismantled after crushing 200 or 300 tons for a yield of 2½ dwt. of gold per ton.

There has been a battery near the All Nations Hotel for the last eighteen months, but considerable dissatisfaction has been expressed owing to delays caused by the repetition of break-downs, which, taken with the distance from the claims and the late developments in the deep "cement" ground at the Ridge, have justified the erection of a battery on the spot.

The miners have lately come to terms with a battery-owner, and the erection of a ten-head stamper battery on the Deep Ground is now (April, 1905) complete.

Output.—The two gold-buyers on the field have given me the following information.—Mr. Noonan, during the first half of 1904, turned over an average of 40 or 50 oz. a week, but during July there was a slight falling off, and in August the weekly turnover was only 10 oz.—this being due to the working out of the shallow claims at the head of Gowrie Creek. Mr. Small, in 1903, bought a total amount of 1,200 oz. His buyings in 1904 amounted to only 50 oz. in May, but jumped to 274 oz. in June, owing to the opening up of the Deep Ground. In addition to these quantities, a considerable amount goes direct to Clermont, and no record can be had of it.

The Warden gives the whole alluvial output of the Clermont fields for the year 1904 as 6,876¾ oz., the greater part of which came from the Black Ridge. The value is given as £4 per oz.

4. PREVIOUS REPORTS.

Mr. Dunstan, Acting Government Geologist, in his report* on the field, revises previous reports by Dr. Jack† and Mr. Rands,‡ previous Government Geologists of Queensland, but we have not been able to secure reports understood to have been written by Messrs. Clark and Daintree.

Mr. Dunstan's report includes descriptions of the alluvial deposits, the reefs, and the geology of the Clermont district. Numerous localities and leads now deserted and not mentioned here will be found described in it, and quotations from it appear below.

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* The Clermont Goldfield, with a description of Dry-blowers and other improvements in Alluvial Gold-saving Appliances. By B. Dunstan, F.G.S., Assistant Government Geologist. Brisbane: By Authority, 1902 (G.S.Q.P., No. 176)

† Annual Progress Report of the Geological Survey for the year 1894. By Authority: Brisbane, 1895 (G.S.Q.P., No. 103).

‡ The Geology and Mineral Deposits of the country in the vicinity of Clermont. W.H.R. By Authority: Brisbane, 1886 (G.S.Q-P., No. 27).

5. MAP.

The field work for the map published herewith was done with aneroid and a Gannet plane-table, with telescopic alidade, fitted with stadia wires, but without an arc for reading vertical angles. With such a plane-table only approximate work could be carried out, and the result is, therefore, little better than an accurate sketch map. The contours give the general configuration of the country, but the slopes on the downs are so slight that it would perhaps have been better to have dispensed with the aneroid, the amount of corrections necessary being altogether out of proportion to the value of the results. A plane-table, such as Johnson's, which is used by the U. S. Geological Survey, could have been used with far greater accuracy, and with a considerable saving of time.

Little time was given to the delimitation of the various geological formations, but it has been possible to sketch most of them in from the points fixed on the traverses. The following explanations are necessary with regard to the various coloured areas shown on the map:—

Basalt.—The areas are mostly covered with black soil, part of which in the gullies may be alluvial. The basaltic area is known in one case (*i.e.*, south-east of the Black Ridge) to extend beyond the limits shown, shafts having proved basalt in sinking; but, the surface soil being light, these extensions could not be marked in with any degree of certainty. Red sintery clay deposits have been sometimes included with the black soil, these deposits having been perhaps derived from the decomposition of basalt.

Actual outcrops of basalt are comparatively scarce, the rock when found being generally dense, with no porphyritic crystals, except olivine. In some cases, as to the northwards of portion 173, its weathering indicates a columnar structure.

It is often noticeable that, on the edge of the black soil downs, the soil has a chocolate tinge, and it is therefore assumed that, when a light chocolate patch occurs out on the downs, it indicates that the coal measures or schists are at no great depth. That there is reason in this is proved by the general occurrence of fragments of quartz with boulders of "billy" and magnesite, in the soil in these patches. Such a belt of soil lies between the Deep Ground and the main Northern road to the south-west, and it is believed to indicate the existence of a "bar" of schist, near the surface.

The black soil downs are generally almost destitute of timber (the exceptions being a few emu-apples, &c.), but where the chocolate tinge appears there is often a thin growth of stunted timber (gum-topped box, bloodwood, &c.).

Schists.—It is seldom that an outcrop of schist is to be seen, except in the watercourses, but, when veined with quartz, the angular

Photo., L.C.B. "TISH." **Plate 2.**

CREEK SOUTH OF SCHNUFFLER'S DAM.

Photo., L.C.B. **FRASER'S WHIM, BLACK RIDGE.** **Plate 3.**

SHOWING VENTILATING FURNACE ON THE LEFT AND HAND-POWER FAN ON THE RIGHT OF THE POPPET LEGS.

fragments of that mineral in the soil betray its presence. Generally the surface is light and clayey, and, as sometimes the coal measures form a soil identical in appearance, it is often impossible to indicate, after simple inspection, what the rock beneath may be. The schists sometimes form a stiff deep red residual clay, which it is extremely difficult to distinguish from that formed by the decomposition of basalt.

Coal Measures.—These, when consisting of conglomerate, are easily determined. The soil is mostly light clayey, and occasional rounded pebbles of quartz can usually be found in it. When strongly coloured the former extension of a basalt cap is almost certain.

Near the surface the conglomerates, sandstones, and shales of the measures are in most cases bleached white, but in the deeper ground they take the colour of the bedrock—white, blue, green, red, or yellow.

Brigalow and rosewood are here almost a sure sign of coal measures. The Black Ridge itself owes its name to the strong belt of dingy-foliaged brigalow, extending along the outcrop of the auriferous conglomerates.

The formation known as "tish," which occurs towards the base of the coal measures, causes much trouble in determining the boundary of schist and coal measures. As it is formed almost completely of angular and sub-angular fragments of schist, it is not possible to distinguish the division between the two on the surface, unless a section is actually exposed. The "tish" always occurs with, and is sometimes interbedded in, the coal measures, and may, therefore, be taken as belonging to them. Its origin has not yet been worked out, for it is inconceivable that such soft material could form either a talus or a glacial moraine, and the deposits resemble nothing else. (Plate 2.)

"*Billy.*"—This rock is shown on the map only where there are distinct outcrops, though it may possibly underlie large areas of the black soil, and has been proved under a considerable area at the Ridge.

6. VENTILATION.

For ventilating the mines, various plans have been tried at the Ridge. The windsail is, of course, the most common, and consists of a sail causing a current of air to be deflected from the horizontal into a large canvas hose, leading to the bottom of the shaft. On calm days this is useless, and in shaft-sinking two other methods have been resorted to—viz., (1) a hand-power fan to drive a current of air to the men working below, and (2) a furnace erected beside the shaft mouth and connected with the shaft bottom by a line of iron piping, up which the air is drawn to the fire. In the accompanying plate, both the furnace and the old hand fan are to be seen. On reaching "wash" an attempt is always made to connect with adjacent workings, and on breaking through there is no further trouble from the air supply.

II.—THE SPRINGS.

The Springs Extended Goldfield embraces: Cement Hill, Linklater's and Victoria Leads, Leonard's Gully, Christmas Hill, Pewt's Hill, and the shallower workings at the Black Ridge, as well as a number of less important localities given below.

The oldest workings are in about the centre of the field, and will be described later on in detail, though they have now been abandoned by all except a few dry-blowers and an occasional party of fossickers, who clean out an old shaft to re-try the "wash" left standing.

1. CEMENT HILL.

The existence of gold (coarse and rounded) was first proved here in 1865, the discovery being the cause of all the work since done in this direction from Clermont.

The hill, which rises only about 70 feet above Gowrie Creek, lies just outside the north-western corner of portion 47, Apsley, and is within ½ mile of the Main Northern Road and telegraph line, at a point 11 miles west-by-north of Clermont. It is really the end of a low ridge or escarpment overlooking Gowrie Creek on the west.

The strata forming the hill have already been shown by Mr. Rands* to consist of (*a*) a bed of conglomerate of schist and quartz pebbles in a clayey cement, the lower four or five feet of which is auriferous; (*b*) beneath the conglomerate a fine-grained silt and sandstone, one to four feet thick, dipping 5 to 25 degrees west and south-west into the hill, in which Mr. Rands found impressions of Glossopteris; and (*c*) a deposit up to 40 feet in thickness of a "tish" formed of schistose pebbles, and much quartz, less rounded and in a coarser state than the upper gold-bearing "wash."

(A) Surfacing.

The worked ground tails off on the southern side, but practically the whole of the northern and eastern slopes of the hill have been "surfaced."

Prospector's Gully, on the northern side, in which, as its name indicates, the discovery was made, was the richest part of the Hill. From the P.C. it is reported, on good authority, that £2,500 worth of gold was taken, the ground being all shallow.

Still, at odd times dry-blowers may be seen going over the old ground. It is, in fact, the dry-blowers who have done the greater part of the surfacing here as elsewhere, most of the ground being too poor to pay for cartage of the "wash" to water.

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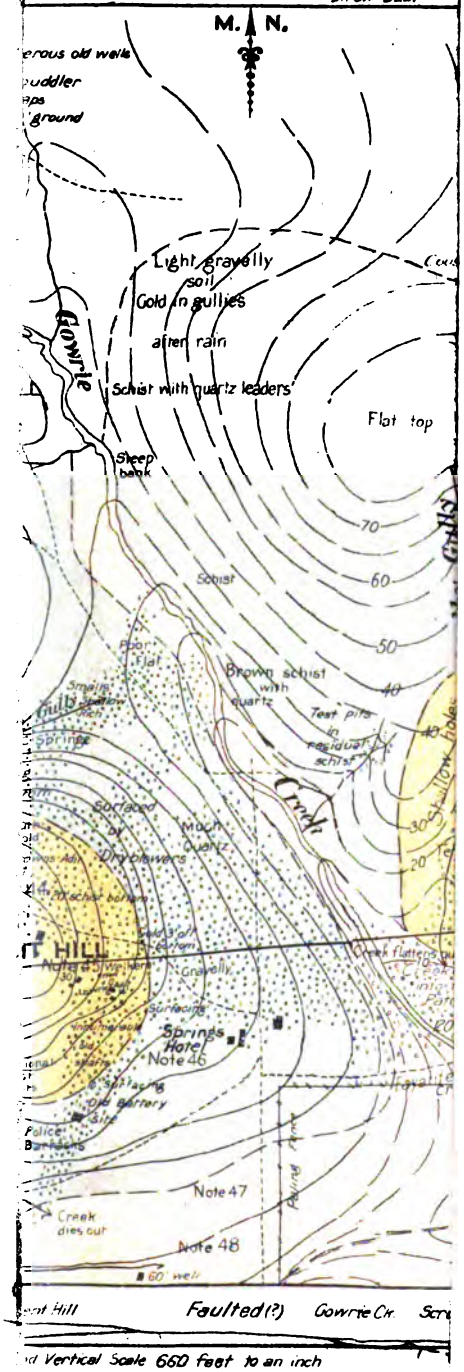
* G.S.Q.P., No. 27.

GEOLOGICAL SKETCH MAP 3
with section
of
THE SPRINGS
(To accompany G.S.Q. report No 201)
By
LIONEL C. BALL B.E.
Assistant Government Geologist
1905
Scale 10 chains to an inch

D. FOX DELT



(B) Shallow Ground.

It was soon proved, in exposing the bedrock, that the gold had been derived from a basal bed of conglomerate, which dipped westwards into the hill. Sinking resulted as a matter of course, and some rich ground was worked in the shallower claims, where it is reported the gold lay in north and south "runs." Lorrie's was the only claim held on the Hill in 1904, but the three adits described below were partly open to view. They are on the outcrop of the "cement."

Lorrie's.—On the eastern slope of the hill overlooking the Springs Hotel.

The three shafts are—the first, 16 feet deep; the second (50 feet to the west), 33 feet deep; and the third (45 feet further west), 44 feet deep. A stope has been carried 30 feet westwards from the shallowest shaft, and a drive extends 16 feet to the south from the second. The sinking is all conglomerate.

The "wash," quite free from clay and very coarse, contains pebbles of the underlying fine-grained "tish" and some granite, the latter quite decomposed. The pebbles lie more often than not parallel to the bottom.

In the "wash" in the western shaft can be seen a three to nine inch north and south zone, whitened and softened, the zone itself being barren, though the "wash" in its neighbourhood is auriferous. It is reported to continue north and south into other claims, and appears to be a solution channel. In the shallow shaft, between the ordinary "tish" and "headlings," there is from three inches to a foot of iron-stained "tish," one inch of which is rich in gold. This rock is known as "fire rock." It thickens and passes into the roof to the west. The gold is all fine and rough, and is found on the steeper sidlings, the ground where the bottom is flat, being poor.

For treatment, seven or eight inches of "wash" is separated, broken up, and washed in a dish, for yields of from 12 to 15 dwt. per load.

The westward slope of the bottom of the "wash" (or surface of the "tish") increases from 1 in 5 at the 15-feet shaft to 1 in 3, and then flattens at the second shaft, the general average being about 1 in 4.

The underlying rocks have a much flatter dip in the same direction, as shown by the interbedded fine fossiliferous white shale in the "tish," which, as a matter of fact, differs from the "wash" only in being finer-grained and in containing more schist. This is evidently a case of contemporaneous erosion, with a slight unconformability.

Knust's (?) Adit (abandoned).—On the northern side of the hill adjacent to Prospector's Gully.

The adit is believed to have been 1½ chains in length, but is now filled in. The run of gold was followed westwards for three chains, and then to the south.

The bedrock at the outcrop is a fine sandstone, dipping 1 in 5 to the south-south-west.

Brown's (?) Adit (abandoned).—East of the above. After the claim had been thrown up by Brown, a company secured it with the results stated below.

This adit runs into the hill to the south-south-west for 2½ chains, a shaft at the end being 50 feet deep.

The "wash" is coarse and not quite conformable with the bottom, though the separate pebbles are generally parallel to it.

The company broke down six feet of "wash" near the outcrop, so forming a wide chamber, from which they put another drive in to the south-south-west. Several hundred tons were crushed for a rumoured yield of 5 or 6 dwt., which did not pay expenses, and operations were in consequence suspended.

Near the surface the bottom slopes 1 in 5, further in it flattens, but soon again becomes steep.

The bedrock for a chain from the outcrop is a white sandstone, and beyond that is a brown shale.

McGregor's (?) Adit (abandoned).—On the eastern side of the hill. The adit, which is 40 feet in length, was opened nineteen years ago. Mr. Rands mentions that the ground contained, as proved by several months' working, 5 or 6 dwt. per ton, but that it was not then (in 1884) possible to make such an amount pay expenses.

Douglas's (?) (abandoned).—At the head of Prospector's Gully.

The shaft is 35 feet deep, and good gold is reported. Eighteen months' work was done here.

Bottom dips to the west, but gold is reported to have run along a sidling to the south.

Gerard's (abandoned).—Two and a-half chains to north-north-west of Douglas's.

A semicircular area north of the shaft has been worked out. The gold was believed to run to Douglas's claim.

Dr. Jack refers to a Gerard's shaft, 28 feet deep, in which the bottom was grey silt dipping to the south-west, but its position is doubtful.

(c) Deep Ground.

A line of comparatively deep shafts runs westwards along the crest of Cement Hill. The "wash," though auriferous (much of the ground containing ½ oz. gold per ton), was, owing to its hardness, not considered payable.

Burn's (abandoned).—At the head of Barracks Gully on the southern side of the hill.

The shaft, 70 feet deep, was sunk at the beginning of 1904.

The "wash" is a red "cement," carrying from ½ oz. up to 2 oz. to the load, and thirty loads were crushed. It is believed that the "pay wash" was worked out.

Bottom appears to have been carbonaceous shale.

Photo., L.C.B. **Plate 4.**

SURFACING ON LIMESTONE HILL.

SHOWING DRY-JIGGER AND THICKNESS OF GOLD-BEARING SOIL.

2. SPRINGS CREEK.

The extension of the "wash" westwards of Cement Hill, has been prospected on the slopes of a steep hill, on the opposite side of Springs Creek, ¼ mile from the former hill.

Craven's (abandoned).—At the foot of the ridge.

The shaft is between 80 and 90 feet deep. The strata pierced include conglomerates, carbonaceous shales, and "tish," while just above the "wash" a seam of coal was cut.

The bedrock is brown slaty schist.

Towards the ridge top, to the south-west of Craven's, there are several abandoned shafts within a circumscribed area, near the boundary of the schists and coal measures. The depth varies from 10 feet to 100 feet, indicating either the presence of cañons or of faulting. Abundant fossil leaf impressions are to be found on the tips.

3. WHITE HILL.

This is really a continuation of Cement Hill, westwards of Prospector's Gully. The deepest shaft at the time of Dr. Jack's visit was 90 feet, and in it the "wash" dirt rested directly on schist.

The claims on the western slope of the hill proved most profitable, and the shafts there, all deserted, are very numerous.

4. McFAYDEN'S LEAD.

This runs north from White Hill, into Gowrie Creek, just below the All Nations Hotel. It was narrow, and the only payable ground was in McFayden's claim, near the lower end.

Some unsuccessful prospecting has been undertaken, with Government assistance, beyond Gowrie Creek, in wet ground, on the prolongation of this lead and the surfacing on Pewt's Hill.

5. LIMESTONE HILL.

This is a low ridge on the right bank of Gowrie Creek, between the battery and the Springs road. The name is due to the deposits on it of "clinker"—a secondary magnesic calcium carbonate derived from the decomposition of the basalt, and proving that its base is not many feet below. The gold is found in from six inches to one foot of dark soil resting on solid "clinker" and mixed with blocks of the same rock. Several dry-blowers have lately been carrying on profitable operations here, and an illustration of one of the machines is shown herewith. (Plate 4.)

6. PEWT'S HILL.

Pewt's Hill lies about ½ mile north-north-west of Cement Hill, and overlooks the All Nations Hotel and battery from the west. Part of the shallow ground on the east was opened thirty years ago.

Dr. Jack noticed that the bottom is slate, and that its depth increases towards the summit, the slope being to the west. Payable gold had been found in the most western shaft. Few shafts have been sunk on the crown of the hill, owing, it is said, to the hard bottom, most of the claims (past and present) being on the south.

Well's and Hill's (formerly Barne's).—South-west of the hill.

The shaft, 95 feet deep, was sunk all in "conglomerate," in 1892. The workings now open consist of drives running 25 feet west-north-west and 30 feet east-south-east from the shaft, and there are understood to be other filled-in drives extending north-north-east and south.

The "wash" is light-coloured and coarse, containing much slate and decomposed granite (soft kaolin-turgite rock), with not a great amount of quartz. Both waterworn and angular gold, with much "paint" gold, are found on flats under the dips.

For treatment five inches of "wash" and five inches of bottom are broken down. A few crushings have been obtained, of 24 and 26 dwt. per ton, from the south side of the shaft. In August, 1904, the following crushing, of stone accumulated during the two previous months, was made:—

19 tons yielded 8 oz.—equal to 8 dwt. 10 gr. per ton.

The bottom appears to slope from the shaft in all directions, at as much as 1 in 5.

Schistose quartzite and clay-schist form the bottom, with "paint" gold on limonite-stained faces, for six inches from the "wash." Lenticular quartz leaders strike east and west, and near them the best prospects are found.

Ringe's (abandoned).—About three chains east-north-east of the above.

The shaft is 92 feet deep.

The gold occurred in trails in the "wash," and also in the bottom, the yield being about 11 dwt. to the load.

Carroll's.—At Ellis's house, five chains west-south-west of Well's and Hill's.

The shaft is 160 feet deep (30 feet of water). It was sunk by Carroll in 1896 to a depth of 116 feet, and then abandoned by him. Bedford continued the sinking, but abandoned it on bottoming.

A current rumour that 18 inches of very hard wash carried 2 gr. to the dish was disproved by Miles and party during my visit.

There is a grey mica-schist bottom.

7. BLACK GULLY.

This is a small depression on the northern side of Pewt's Hill, and the workings on the two are continuous.

8. PINK HILL.

The hill lies north-west of Black Gully, above which a run of gold has been worked.

On the south-eastern slope of the hill gold has been found at 30 feet depth, on a false bottom 10 feet above the schist bedrock.

9. BLACK RIDGE.

The shallower workings at the Black Ridge—*i.e.*, those east of the Drummond Range divide—are included in the Springs Goldfield, but the description of them will be placed under the third general heading "Black Ridge."

10. LINKLATER'S LEAD.

Linklater's lies on the spur upon the eastern side of Gowrie Creek, opposite the Springs Hotel.

A surface "run" was followed, thirty years ago, south-south-eastwards down a steep ridge from the summit. Near the ridge top the "dirt" was a couple of feet deep and two chains wide, but down the hill the depth increased to 12 feet, and the width decreased to ten feet, near Appleton's shaft.

On the south, near Dodger's Flat, dry-blowing is still being carried on, the gold-bearing "wash" occurring on a false bottom, 18 inches from the surface.

Appleton's.—About half-way down the ridge. The shaft was sunk in the bottom of the surface lead, to a depth of 134 feet, the sinking consisting of bluish "cement" (conglomerate), red sandstone, fossiliferous shale, and fire-clay, in which several thin seams of coal are reported to have been cut; in fact, fragments of coal can be found on the tip. The schist bottom was not reached, owing to lack of funds.

11. VICTORIA LEAD.

This is supposed to be the northern continuation of Linklater's Lead, and was in full working during 1879. It was always reported to be very crooked and narrow. "The Victoria Lead at the summit of the hill . . . . was only 15 to 20 feet deep, ... but to the north, where it ran under the basalt, it was 100 feet deep. . . . Its average width is from 20 to 30 feet," and "the wash dirt is said to have averaged 1½ oz. to the load all the way through."*

The depth of "wash" taken, for an average yield of an ounce per load, was up to two feet.

Dr. Jack says:† "The Victoria Lead lies in a gutter, between the 'tish' on the east side and a slate bottom on the west. . . . On

* G.S.Q.P., No. 27.
† G.S.Q.P., No. 103

reaching the flat the lead turns to the north-north-west," and "from this point for 80 or 90 feet the lead contained very good gold." In 60 to 90 feet ground here Dr. Jack mentions that the wash yielded at the rate of 36 oz. to the load. In the Windlass shaft (130 feet south-south-east of the All Nations shaft) then open, he found the following section:—

Basalt	40 feet
Clay and sand	7 feet
Gravelly drift	100 feet.

Influx of water has always retarded the proving of this ground. The continuation of the lead is believed to be towards the north-north-west, from the All Nations.

All Nations.—The furthest out (most northerly) claim on the lead.

The claim was abandoned in July, because the prospects were too poor.

The shaft, 145 feet deep, bottomed on schist.

Gold-bearing "wash" has been reported at three different levels, which is interesting and important even though the ground in the upper levels is unpayable:—

(1) At the 100-feet level is a poor layer of wash.

(2) On the 125-feet level openings were made 6 feet to north and 6 feet to west, proving the "wash" to be auriferous, but not payable.

(3) At the 137-feet level is a 55-feet drive to the north on a channel 12 feet wide (18 inches wide in shaft). There is also a drive for 40 feet to the south, and one for over 100 feet to the west.

The "wash" (with blue clay, in which marcasite occurs) which has been hitherto taken as payably auriferous, was 12 inches thick. The gold in this level is coarse; in upper levels very light and spongy. It is reported to have averaged 1 oz. to the load, but in the face there is now only ½-oz. dirt showing, and that is considered to be too thin to be profitably treated here.

It is said that the gold with black seams always dips north-west, irrespective of the particular slope of the bottom, so that it reaches within ten feet of the surface at a point only 300 feet to south-east of this claim.

Beneath the "wash" is 9 feet of "tish."

12. DODGER'S FLAT.

This depression commences on the black soil downs, and extends south into Gowrie Creek. Its tributaries include the following:—

St. Patrick's Gully.

St. Patrick's Gully, rising on the Victoria Lead, runs east-south-eastwards. The gold, never abundant, was found in shallow "tish" ground.

Cousin's.—The shaft on the Flat, near the junction of the gully, proved ten feet black soil and ten feet brown conglomerate.

BULLOCKY GULLY.

Bullocky Gully is a short ravine on the eastern side of Dodger's Flat. There are numbers of shafts in it, the gold having been followed up to the base of the coal measures.

13. SMITH'S HILL.

This is the escarpment on the eastern side of Dodger's Flat. The whole hillside down to the flat has been worked over, like Cement Hill, below the basal conglomerate beds of the coal measures (sometimes called "tish"), which here are dipping south-easterly into the hill. Even now a few dry-blowers are at work on the hillside. Only one or two shafts have been sunk in the coal measures, and nothing is known about them.

The "wash" consists of rounded quartz, pilotstone, &c.

MORGAN'S GULLY.

A ravine on the southern side of Smith's Hill, which gave very good returns.

DUFFER GULLY.

Nearly half encircles Smith's Hill on the east. Deep shafts were sunk in the flat, but no gold was found.

14. LEONARD'S GULLY.

The gully, lying a mile east of the Springs Hotel, runs from north to south. The lead has been followed for ten chains diagonally up the slope to the north-east.

The "wash" appears to belong to the coal measures, here forming only a cap (15 feet thick near the hilltop, but much thicker in the gully).

Ringe's.—Halfway up the gully.

The shaft is 75 feet deep, the sinking being hard ferruginous "cement," with bands of fine-grained sandstone. It was not bottomed because of the large amount of water met with.

The dip is probably to the south-east or east, as the basal beds outcrop within ten yards to the north-west. In the shallower shafts in the vicinity gold was found in a surface "wash" with "billy" and basalt on a ferruginous "cement."

15. CHRISTMAS HILL.

Christmas Hill lies about a mile east-south-east of the Springs Hotel, and is a continuation of a broken ridge extending eastwards from Gowrie Creek. It rises about 50 feet above the black soil plain on the south.

The hill has been "surfaced" across from north-west to south-east, the bottom exposed being coal measures (ironstone). Most of this work was done thirty years ago, but still a little dry-blowing is attempted occasionally.

Otter's (abandoned).—On the south-eastern side of the hill.

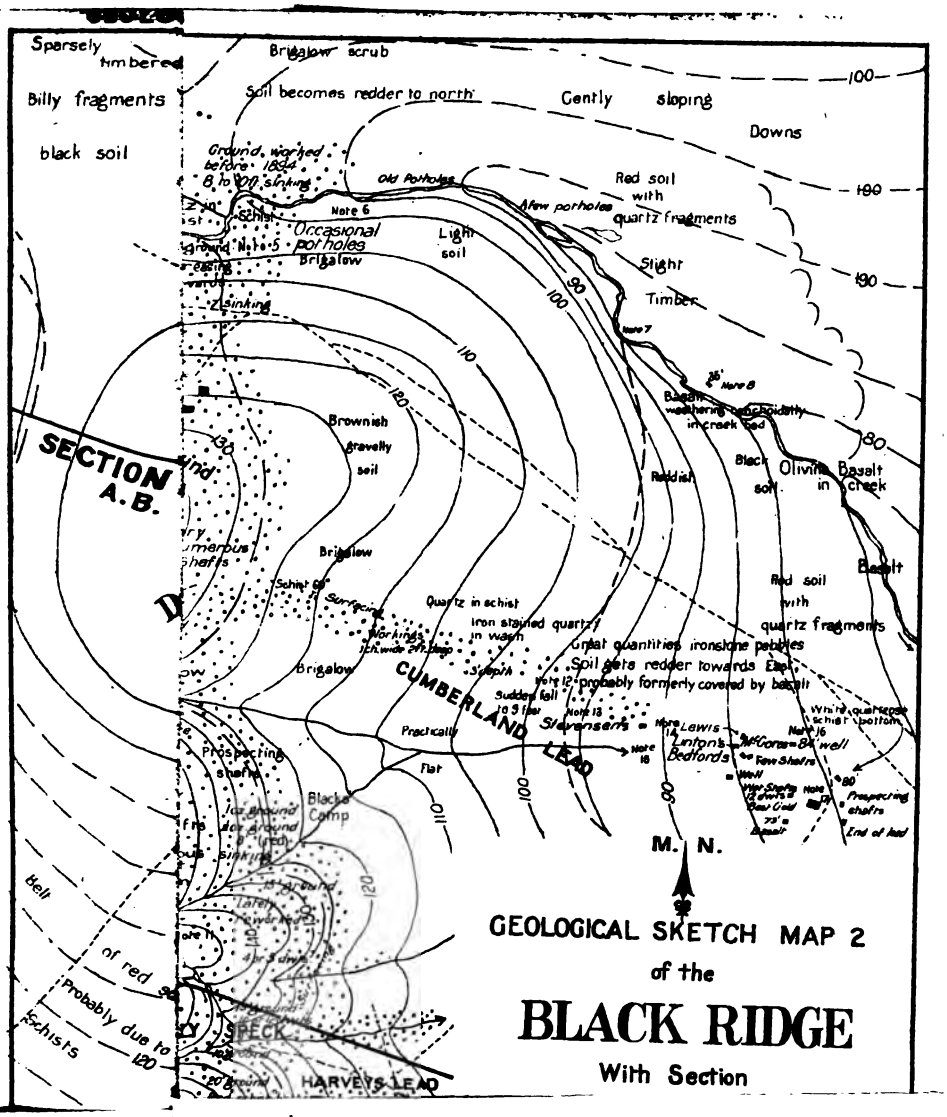
The shaft, 12 feet deep, was sunk in sandstone and conglomerate, overlying a bed of white shale containing fossil leaves (glossopteris, gangamopteris, &c.) Drives, formerly extended 15 feet to the east (now filled in) and 35 feet to the west-north-west, where a 17-feet shaft communicates with the surface. The ground east of this second shaft (similar in appearance to the ordinary Black Ridge red "cement") has been stoped out over an area 15 feet in diameter, in which the bottom slopes 1 in 12 to the south-west.

The bottom in some places is limonite, and in others a conglomerate of pebbles and shale, but it is nowhere schist.

A third shaft, 37 feet deep, now inaccessible, lies 30 feet south of that last mentioned, the slope in it being 1 in 3 to the south-south-west. At the bottom of this shaft a 3-oz. "colour" is said to have been found.

A shaft, about a chain north-west of Otter's, is 25 feet deep; one, a chain to the south, is 60 or 70 feet deep; and another, 2½ chains to the north, is 60 feet deep. The last passed through white, red, and blue "wash," but it did not bottom, and no gold was found. These shafts prove that Otter's claim is on the "point" of a subterranean ridge and not in a trough or gutter.

The "wash" includes granite, schist, and quartz pebbles. All the gold from these workings was coarse.



GEOLOGICAL SKETCH MAP 2

of the

BLACK RIDGE

With Section

Photo., L.C.B. SHALLOW GROUND EAST OF GOWRIE CREEK, BLACK RIDGE. Plate 5.

LOOKING FROM HILLSIDE CLAIMS.

III.—BLACK RIDGE.

1. HISTORY.

The discovery of gold at the northern extremity of the Black Ridge, a low brigalow-covered escarpment. on the eastern side of the head of Gowrie Creek, was announced by Messrs. Fox and Aplin in March, 1895; (though gold had been found and worked in Gowrie Creek on the north as early as 1892); and, the ground being shallow, the field was soon supporting a population of about a thousand men.

Fox's Lead (or Trail) was narrow and rich, and extended westwards a total distance of about ten chains, the depth increasing from 25 to 50 feet. From it the workings gradually extended southwards along the Ridge.

On the eastern side of the Ridge the ground was shallow, much of it surfacing for a distance of nearly a mile; but westwards the depth of the "wash" increased and the number of men on the field fell off; though, during 1899 and 1900, some success was achieved in opening up the Slaughter-yard, Daintree's Knob, and Hard Hill Leads. (Plate 5.) Nearly the whole of the ground on the Black Ridge, east of Gowrie Creek, has now been worked out, and the only hope for the future lies in the west.

The occurrence of a layer of "billy" along Gowrie Creek retarded prospecting to the west of Fox's Lead, but after the discovery of payable gold, in September, 1903, on the Old Cricket Ground, the whole flat west of the creek was pegged out, and at the time of my visit a line of claims connected these with the Deep Ground to the south-west.

Working westwards round the head of Gowrie Creek, in 1901, the blue ground was entered at a depth of 160 feet. This, poor at first, became richer as it was followed to the north-west, and proved payable at last in McGillivray's old claim (now Mason's). Though the fact that this ground was giving good returns seems to have been well known, no attempt was made to test that ahead for two years, when Bedford's shaft was sunk on the north. As colours only of gold were got in this, the miners seem to have given up all intention of further testing until, in the beginning of 1904, McGillivray, throwing up his old claim, took up another on the western side of it. This gave the necessary indication, and four other claims were taken up on the same line, with the result that gold was struck in all of them before the end of the year.

After the finding of payable gold by Madge (who held the outermost of the abovementioned four claims), the ground was pegged out on both sides of the line of deep shafts. When the writer left the field there were two shafts going down on the northern side, but, at the beginning of 1905, there were at least nine in process of sinking.

There is a small area between Daintree's Knob and the Deep Ground that gives promise, and will require prospecting; but the main extent of the ground is to the west and the north, in which directions no prospecting to speak of has been done.

2. SUMMARY.

(A) Extent Proved Auriferous.

The ground worked extends northwards for a little over a mile from the surfacing at the southern end of Hard Hill, and westwards for a little under a mile from the workings on Flyspeck Gully. There has hitherto been only one gap of any extent in this area (*i.e.*, between Daintree's Knob and the Deep Ground), but this is now being sunk on and may prove as rich as any of the portions yet tried.

(B) Origin of the "Wash."

The "wash," as elsewhere indicated, is the lowermost portion of the basal conglomerate of the Bowen Coal Measures, which rest on a bedrock of schist sloping gently westwards; so that the workings, though at first comprising only "surfacing," are now nearly 250 feet deep.

It has not been proved that the conglomerates are in a "lead," in the sense of an old river channel, and the "wash" (or "cement" or conglomerate, however it may be termed) will in all probability be proved to mark the site of an estuary- or a lake-shore. If a sea-shore one would expect to find included marine shells; and, while their absence may be insufficient alone to disprove any seashore theory, the occurrence of an abundant land flora in the interbedded shales proves that they were laid down in fresh water.

It would be quite possible to have a river bed a mile wide (the proven width of the "wash" at the Ridge, though the conglomerate probably is still more extensive), but the beds have been so disturbed—raised in one part and lowered in another—that any form of channel, if such originally existed, can no longer be distinguished. If there were a river, its course must have been north-west and south-east (*i.e.*, on a line connecting the Springs and the Deep Ground). Beyond the Deep Ground, the channel should be expected to continue towards the Seventeen-mile Well, whence, after junctioning with the run from McMaster's, it would continue to the Miclere. There would be even a possibility of all three runs—Black Ridge, McMaster's, and Miclere—being tributary to one main channel beneath the basalt, the direction of which can as yet not be indicated.

If the conglomerate be a lacustrine or estuarine deposit, and if it be conceded that the gold has been introduced subsequently to its consolidation, it can be conceived that the solutions would tend to flow, to some extent, along the troughs in the bedrock, so giving the appearance of a lead, or a number of runs.

(c) Nature of Auriferous "Wash."

Generally speaking, the "wash," to be favourable for gold, requires to be composed in greater part of sub-angular fragments of schist, with few or no quartz pebbles, though pilot stones may be abundant, while much sand is distinctly unfavourable. In the deeper ground the colour is usually bluish-green, this being due to salts of iron, as indicated by the colour at lesser depths changing to red. The iron stains have in most of the very shallow ground been almost completely leached out leaving the "wash" white.

The whole of the ground is not blocked out and broken down, but it is found that the gold occurs in runs (often locally called "leads") and patches, and some considerable areas have been left untouched, because believed to be barren or too poor to pay.

The most favourable bottom is one sloping westwards, with the laminæ of the bedrock dipping at a high angle in the same direction. Gold is especially abundant along the western sides of "bars," which in most cases appear to be due to faulting.

(d) Origin of the Gold.

The location and state of the gold, which will be referred to under the heading of "Present Conditions," leads one to the conclusion that it was not deposited at the time the "wash" was laid down, but since. Its occurrence on "false bottoms" and on rolls and sidlings, in preference to flats and gutters, is evidence against mechanical deposition, and the "paint" gold occurring so universally on the laminæ of the bedrock is strong evidence in favour of its deposition from solution. The frequent richness of the "wash" along falls and "bars" in the bottom (which have in most cases been produced by faulting), and the occurrence of gold so often above fissures and quartz lenses in the bedrock, both indicate precipitation from solution, these lines of weakness having presumably given passage to the auriferous solutions (or possibly to the preciptating agents).

In the description of Donaldson's claim it will be noticed that, in damp weather, a slight seepage, from the schists in the shaft bottom, is to be seen, proving that even now solutions are exuding from the bedrock, though the "wash" is practically dry. Patches of surfacing are occasionally met with in schist country (as at Black Johnson's and the Mystery), the gold in which it is difficult to account for, except on the hypothesis that it has been derived in solution from the rock beneath.

Bedrock would offer some check to the downward course of solutions circulating in the "wash," though other solutions under greater pressure might exude from the bedrock. The solutions would thus mix and react upon one another in the vicinity of the bottom of the "wash," and the precipitated gold would consequently be found there.

It seems likely that the auriferous solutions welled from the schists, and that the precipitating solutions circulated in the "wash," for the occurrence of gold in reefs and leaders in schists is common, while the presence of a precipitating agent in the schists is most uncommon. Sulphuretted hydrogen, however, was found in one quartz vein in schist in the Clermont district (*see* Callan's, in Appendix 2), but the example is the exception to the general rule.

As for the nature of the precipitant, one of the most common is carbonaceous matter, of which there may have been considerable quantities in the "wash" originally, though little is now to be found and that generally in intercalated shales. It is not likely to have ever been so widely distributed as the occurrence of the gold would necessitate. Another favourite precipitant is pyrite, but at the Black Ridge it has in almost all cases been found that, where pyrite (or marcasite) is most abundant, the "wash" is poorest in gold; and, further, a sample of pyrite from one of the claims on Gowrie Creek assayed for Mr. Dunstan contained only a few pennyweights per ton. The pyrite, or more probably marcasite, is found not alone filling cracks in quartz, but also coating pebbles themselves; besides which it must occur in considerable quantities in the "wash" in some parts, to judge by the rapid decomposition of the latter, with accompanying and consequent efflorescence of sulphates. It may, therefore, be taken as a secondary mineral in the "wash," deposited probably contemporaneously with the gold. The presence of this sulphide points to the former existence of an excess of sulphuretted hydrogen, a gas given off during volcanic eruptions. It is, therefore, possible that this gas might have found its way through the basal conglomerate from volcanic necks or fissures piercing the coal measures. Such necks or fissures, up which the basalts, now covering the coal measures in greater part, could find their way, there must of course have been.

It is believed that thus all the various conditions under which the gold is found here may be accounted for. It would not be necessary that either or both of the solutions should permeate the whole area of the wash at one time. The solutions may have been of limited volume, and that from the schist given off from limited areas, they would in that case tend to follow certain "runs," and so might never reach some parts of the "wash," which would, therefore, remain barren.

It has long been held by some writers that the gold in the "banket," on the South African Rand, was introduced subsequently to the consolidation of the conglomerates; and, though others deny the possibility, most of the evidence seems to be in its favour. The latest paper on the subject is that of Hatch and Corstorphine,* in which it is stated that the conglomerates consist chiefly of rolled fragments of

* Petrography of the Witwatersrand Conglomerates. By Frederick H. Hatch and Geo. S. Corstorphine. Trans. Geol. Soc., S. Africa. Reviewed in "Mining Magazine," Apr., 1905.

quartz, and occasionally quartzite, banded chert, and slate, cemented by secondary quartz. Pyrite is common with a radiate and concentric structure, and small black spots of carbonaceous matter occur, the gold encrusting both minerals. The authors conclude that the gold was brought in by the same percolating waters that carried the cementing material of the conglomerate; and that it was precipitated possibly by the pyrite, and in places by the carbonaceous matter. Their reasons for believing in the infiltration theory are:—"(1) The gold is practically confined to the matrix of the conglomerate, and occurs there in association with other minerals of secondary origin. The few rare cases in which we have seen gold in the pebbles were obviously instances of infiltration along cracks—a fact which in itself tends to support the theory. (2) The gold occurs in crystalline particles, often surrounded or lying in close association with pyrites, crystals or concretions, which are of secondary origin. (3) The almost uniform fineness of the distribution of the gold. (4) The restriction of the gold to certain definite beds."

There is thus a strong similarity between the Black Ridge and the Witwatersrand, and the future for the former is thereby rendered all the brighter.

3. FUTURE PROSPECTS.

(A) Probable Direction and Depth of Continuation of Auriferous Ground.

The wash at Cement Hill (Springs) and that at the Black Ridge were, in my opinion, formerly continuous. If the "wash" be in a channel, the probable continuation would be to the north-west (though it is of course impossible to say definitely without data what way a stream may turn). Similarly if the "wash" be a shore deposit the evidence seems to show that the continuance of the auriferous ground will be to the north-westwards, even though, just at present (April), it seems to be opening out to the north.

As to the depth of the ground to the north-west, the slope hitherto has been up to 1 in 12, but that has really been on a side channel, and in any case the strata should be expected to rapidly flatten out northwards, as at the Miclere the slope is towards the Ridge. Taking the dip as 1 in 20, the "wash" should lie at a depth of 500 feet at a distance one mile north-west of Heuat's claim (on the Deep Ground).

The main obstacle to the future working of the deep ground will be the zone of water-logged strata beneath the basalt. Already the miners are asking for Government assistance for pumping, but as yet they have not found it impossible to keep back the water. The pressure of the water will increase with the depth of the base of the basalt, and it may prove beyond the individual miner's means to keep it back.

To give an idea of the conditions it may be mentioned that—

Neight has reported raising 1,300 gallons (= say, 6 tons) of water per hour; and

Wyles has reported raising 800 gallons (= say, 3½ tons) of water per hour.

It will, however, always be possible to sink through it, if necessary, by the adoption of some system, such as the Kind-Chaurdon.

(B) Prospecting by Shaft and Drill.

Prospecting by shaft is not likely to be ever undertaken many chains beyond proved auriferous ground, for, though in case of success the shaft may be used for the exploitation of the "wash," failure, which in the majority of cases is to be expected, would mean a greater loss. It would often be necessary to sink a line of shafts or bores, and then everything is in favour of boring.

The cost of shaft sinking would amount to at least 30s. per foot down to 250 feet, and 40s. down to 500 feet depth. Any increased thickness of undecomposed basalt would, of course, amplify these figures, and the striking of a large supply of water beneath the basalt might run them up indefinitely. The last item, the amount of water struck in sinking, would cause no variation in the cost of drilling, which might be put at from 10s. to 20s. per foot. Either jumper-, diamond-, or calyx-drill should prove successful, but the calyx should be specially adapted to the comparatively soft rocks of the Ridge.

4. PRESENT CONDITIONS.

The work done hitherto may, for purposes of description, be divided into surfacing, shallow sinking, and deep sinking, the last two being somewhat arbitrary divisions, as explained below.

(A) Surfacing.

"Surfacing" consists in laying bare the bed-rock by removing the whole of the soil and subsoil. The gold contents have in all cases in the vicinity of the Ridge been derived from an outcrop of "wash" higher up the hillside, and formerly extending outwards over what are now depressions. In some other localities the gold is residual from the degradation of schists veined with auriferous quartz leaders. There is strong presumptive evidence that solution of part of the gold has taken place, in that these residual deposits at the Ridge were no richer—in fact, were often poorer—than the beds from which they were derived.

In this district the poorest material is dry-jigged, and while the richer is dry-blown (Plate 6), the very rich has been carted to the puddlers for treatment. The best returns seem to have been between ½ and 1 oz. to the load.

Photo., L.C.B. **Plate 6.**

DRY-BLOWING ON LIMESTONE HILL.

SHOWING THICKNESS OF SOIL TREATED.

Surfacing began, as explained, at Gowrie Creek, at the northern end of the Black Ridge, and continued southwards past Cumberland's Lead (where much of the work is really only surfacing or "gully raking"), through Flyspeck and Armenian's Gully to Smith's Workings and the Hard Hill Lead, beyond which the ground became too poor to work. The best gold along the outcrop appears to have been in residual soil 10 or 12 feet deep.

At the time of my visit no "surfacing" was going on beyond that done by one or two dry-jiggers and dry-blowers working out the few small patches left at the time of the rush. The earnings of these men were exceedingly small.

(B) Shallow Sinking.*

By sinking is meant the opening of shafts and working out the auriferous "wash" without removing the overburden, and the working miner considers depths of from 6 to 20—and even 50—feet quite ordinary ground; but it requires a certain amount of courage to sink from 50 to 100 feet, while beyond that financial considerations have weight as well. Under the heading of shallow sinking will be described all the working mines to the east of McGillivray's old claim.

Generally the "wash" increased in depth westwards of the surfacing (*i.e.*, the outcrop), on the eastern side of the Black Ridge, and this in spite of the strata dipping beneath the Gowrie Creek depression. Some of the best yields (from 30 dwt. to 4 oz. to the load†) were obtained southwards along the side of the ridge near the outcrop of the conglomerate.

In the middle of 1904, almost all the claims on the western side of the original Black Ridge, and east of Gowrie Creek, either had been or were being abandoned, or were giving signs of rapid exhaustion; and, owing to this fact, the number of unemployed was becoming very perceptible. This, the eastern, part of the ground was characterised by the number of trails with a westerly course.

(*a*) Fox's Lead.

Fox's (or Alpin's) Lead (or Trail) is at the northern end of the Ridge, and on it the original P.C. of the Black Ridge was located.

In Fox's Lead the sinking quickly deepened westwards of the P.C. from 6 feet to 40 feet, and even 50 feet, the yield being from four to five ounces to the load.

On the western side of Gowrie Creek the width of the trail was 15 to 18 feet.

Horwood's.—In the vicinity of the original prospecting claim.

This is one of the few claims on unworked blocks, and in it the "wash" is at a depth of 38 feet.

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* In the descriptions of the claims an attempt will be made to give in order the location, depth and extent of workings, nature of "wash," thickness of "wash" taken and yield of same, slope and character of bottom, bedrock, and any other particulars.

† A load of "wash" is generally computed by the miners to weigh 1½ tons.

(*b*) TURKEY'S NEST.

This was 50-feet ground lying to the south of Fox's Lead, on Gowrie Creek. The claims here are said to have averaged 25 dwt. to the load.

(*c*) CUMBERLAND LEAD.

This narrow trail, generally only a few feet wide, extended from the surface workings on the eastern side of the Black Ridge for nearly ½-mile to the east, the depth gradually increasing to over 80 feet.

Much of the "wash" was dry-blown, and there were, at the time of my visit, one or two men treating the surface soil in the upper part of the lead.

The occurrence of pipeclay, up to 40 feet in thickness, in the eastern portion, is probably due to the decomposition, *in situ*, of basalt.

Linton's.—Situated at the lower end of the lead.

The shaft is 60 feet deep, and bottomed on the side of a pothole or (as it seemed to me) a trough, running north-north-west. A chamber 10 feet in diameter has been opened west of the shaft, and from it a drive continues 10 feet further west along a narrow trail of gold.

The "wash" in the pothole is free puddling, consisting of clay (decomposed slate?) with distributed angular fragments and rounded pebbles and boulders of quartz. The rounded pebbles and boulders have probably sunk from above into the "wash," while the angular fragments were derived from veins in the schist. The thickness of auriferous "wash" is six feet.

The "prospects" range from five pennyweights to two ounces to the load, extraordinary yields (one ounce of coarse gold to the dish) having been obtained in the gutter running west from the pothole, where the gold seemed to be as much in the decomposed clay slate bottom as in the "wash." This trail was lost at about 20 feet from the shaft, and seems to have passed overhead.

The "free wash" overlies auriferous "cement," which requires crushing, and of which most is, therefore, at present left in place. A face of 10 feet of "wash" and "cement" has been exposed in one place, and the returns for the stone broken down and raised from there are:—

8 loads	puddled for	... ...	16 dwt. per load.
9 loads	,,	... ...	8 dwt. ,,
12 loads	,,	34 oz., total = 2 oz. 16 dwt. 16 gr.	,,
12 loads	,,	37 oz., total = 3 oz. 1 dwt. 16 gr.	,,
12 loads	,,	32 oz., total = 2 oz. 13 dwt. 8 gr.	,,
20 loads	,,	... ... 1 oz. up to 3 oz.	,,

The slate side or bottom, east and west of the trough, is probably due to faulting (a throw of seven feet or more), and to that cause the origin of the gold may be due.

The bed-rock is brown sandy micaceous clay-schist.

The claims east of Linton's secured one or two puddlers (20 or 30 tons), but were flooded out early in 1904.

Bedford's.—Adjoins Linton's claim in the south.

It is reported that no "free wash" was found, and that an influx of water from the cement prevented continuation of work.

McGore's.—Four chains east of Linton's.

The shaft, now used as a well, is 84 feet deep.

Colours only of gold were found in the wash, but it is understood that very little driving was done to prove the ground.

(*d*) FLYSPECK.

Flyspeck is one of the ravines on the eastern side of the Ridge.

A considerable amount of work has been done in its vicinity, but, in July, 1904, only one claim was held, and that was in 40-feet ground. The "wash" is "free puddling," and 9 or 10 inches are broken down, the average yield being only about five pennyweights per load.

(*e*) SMITH'S WORKINGS.

A small patch of ground on the point of the ridge, ¼ mile south of Flyspeck.

The "wash" includes much ferruginous quartz. Only a few loads were obtained, for a yield of eight pennyweights per load.

(*f*) WHITE GROUND.

The white ground covers an area of 40 acres near Fox's Lead, on the western slopes at the northern end of the Black Ridge.

The depth of the ground increased rapidly from 10 to 30 feet southwards and westwards.

An area, 10 feet to 14 feet deep, near the point of the Ridge, yielded five pennyweights to the bag, the "wash" having to be carried to the Springs for treatment.

It is recorded that where patches of pink "wash" occurred in the White Ground it was always poor—containing only four or five pennyweights to the load.

(*g*) YELLOW GROUND.

This, richer as a rule than the White, formed an adjoining north-west and south-east belt, covering an area of 10 acres.

In one of the claims on the Yellow Ground, with 40-feet sinking, the gold is reported to have been found both on the true (schist) bottom, and on a false (grit) bottom 15 feet above the schist.

(*h*) RED GROUND (Slaughter Yard Lead).

The Red Ground, 50 acres in area, had, like the Yellow and White, numbers of trails running a little north of west, which were here unusually wide in places. In about the centre of the "Lead" (as the area is called) gold was found in the "headings" five or six feet above the bottom, enabling a second party to work the abandoned ground.

The bed-rock is red schist.

This ground was worked during 1899.

(i) UNWORKED GROUND.

The belt (area 15 acres) lies in the "Slaughter Yard Lead," and extends from the Ridge top to the billiard-room west of Gowrie Creek.

The "wash" in this area is believed to lie at from 60 to 80 feet beneath the surface. It is practically untried, either because the yield in the shallow ground (the outcrop) was poor, or because of a supposed rise in the bottom here, or, more likely, because the ground is known to be hard and the trails narrow (two or three feet in width).

(j) DAINTREE'S KNOB.

The Knob, an outcrop of "billy," at the head of Gowrie Creek, is said to have been named after the then Government Geologist, who visited the locality some thirty years ago.

East of the Knob the auriferous patches were disconnected, and while on the west there were runs, they were in the end lost; it is expected, however, that they will be picked up again still further west or to the north-west.

Mr. Dunstan records that in the shafts here 16 feet to 26 feet of "billy" was pierced. I could obtain no reliable evidence of gold occurring in the "billy," though it had previously been affirmed that a seven-grain speck had been found. It is further recorded that "sometimes the whole of the material of the 'wash' is cemented together with secondary iron pyrite, masses of which are met with in some of the workings," and that the gold present in the "wash" is distinct from that in the mundic. Unfortunately none of the mines were being worked in this pyritous "wash" at the time of my visit, and on the "mullock" heaps the mineral had decomposed. The "mullock" on some of the heaps at Daintree's Knob certainly showed strong indications of having contained much pyrite (or marcasite).

It is understood that the ground, from the head of the lead for ¼ mile to the north, gave an average yield of seven or eight pennyweights per load puddled. (Plate 7.) The greater part of the work in this locality was done during 1901.

Grant's.—East of Daintree's Knob.

This claim has been in operation under different parties for over twelve months. Two men are now producing, by pick and gad work, twelve loads of "dirt" per month.

The main shaft bottomed on "wash" at a depth of 103 feet, and from it all work has been towards the north and east.

The "wash" contains numerous pebbles of decomposed granite, together with schist and quartzite. The majority of the pebbles dip to the south-south-west, at an angle of 30°, and it has been assumed, in consequence, that the stream came from the north-north-east. There is no defined "lead" here, the gold occurring in patches, sometimes 20 feet across, and often disappearing quite suddenly. The boundary between the auriferous and barren ground is, however, indistinguish-

Photo., L.C.B.

SHALLOW GROUND AT HEAD OF GOWRIE CREEK, BLACK RIDGE.

Plate 7

able, and the amount to be saved has to be determined by constant prospecting with the dish. The gold is mostly within 6 to 18 inches of bedrock, though, in some parts up to six or seven pennyweights per load is found from three to six feet above bottom. It is generally absent where the floor is flat.

Some of the gold is found embedded in the bedrock, of which it is therefore necessary to tear up three inches for treatment with the lower six inches (to 18 inches) of "wash." The average yield is 10 dwt. per load.

The bottom rolls to a considerable extent.

The bedrock is schist, the foliæ of which are generally parallel to the old land surface, though at times they are steeply inclined to it. When the foliæ dip in the same direction as the surface of the bottom they form riffles, sometimes six inches high, which have been instrumental in catching the gold, but, when the foliae dip in the opposite direction, riffles are not produced, and the ground is consequently poor.

Dequin's.—West of Daintree's Knob.

This has been one of the most constantly, as well as most profitably, worked claims on the field.

The whip shaft is 116 feet deep, and the windlass shaft (100 feet to the north-east) is 110 feet deep. The shafts are now connected by drives. On both sides of the drive running west from the whip shaft, and round that shaft itself a large area of ground has been worked out.

The depth of the "wash" below the surface is about 110 feet—varying between 100 feet and 120 feet.

The "wash" contains, besides schist, &c., much granite; and, it is noticeable that the change from blue to red (oxidised) "cement" occurs where there is also a distinct change of colour in the bed-rock. Blue fossilferous shale occurs above the "wash" in one place west of the windlass shaft. The miners have found the gold to be most plentiful on top of a "slate bar" (*i.e.*, a ridge in the bottom, produced probably by faulting); and they have also noticed that it lies mostly along brown streaks (fissures?) running west 10° south, through both the "cement" and the schist bottom. The run of gold on the north side of the bar was 40 feet wide. The blue ground south of the "bar" (exposed in the drive to the whip shaft) has been proved to contain only five pennyweights gold to the load, the payable ground lying north of the "bar."

The stone for treatment includes nine inches of "wash" and three inches of bedrock, and the ground worked is said to have averaged 30 dwt. per ton, while it has yielded as high as five and six ounces per ton.

The surface of the bottom is very irregular, but the general fall is to the south-west, as proved by the depths of the shafts.

The schist forming the bedrock is seamed by great numbers of quartz leaders, and it is said that granite dykes have also been seen in it (though this is doubtful).

At the bottom of the windlass shaft is a "mud bar," which may be crushed country on an incipient fault, but sufficient was not exposed for this point to be settled beyond doubt. Spheres of "mundic" (which, owing to their rapid decomposition, are most likely marcasite) are stated to have been found embedded in the "mud."

Carroll's.—Adjoins Dequin's on the north. It is said to have been one of the richest claims. Lately it had been intended to abandon the ground, but the opportune discovery of a new trail of gold, 80 feet east of the shaft, gave hope of continued life.

The shaft is 110 feet deep. East, north, and west of the shaft there is much worked-out ground, that open to view extending 100 feet east, 30 feet north, and 30 feet south of the shaft. It is in the southern face that the last work was done, along a rise in the bottom.

The workings here also are on the northern side of a "bar," believed to be the same as that in Dequin's.

The "wash" in parts (as south of the shaft) is very coarse, and consists in great part of rounded schist, though waterworn boulders of other rocks also occur. Lenticular seams of pyritous shale, dipping with the bottom, were seen in the wash. Both red and blue "wash" occur, and in the eastern face it has been proved that there is no gold in the red "cement" on the bottom, though the overlying blue stone is payably auriferous, the assumption being that the gold has been leached out of the former. All the gold in this claim is coated, two pennyweight "specks" even being indistinguishable in the "wash." The gold is worth £4 1s. 8d. an oz. when cleaned.

For treatment, four inches of bedrock and up to two feet of "wash" are raised. The eastern workings are reported to have yielded from 15 dwt. to two ounces to the load, but the "wash" in the face there contains only eight pennyweights. During the last year the average yield has been over 15 dwt. per load, the June (?), 1904, crushing being for 16¾ dwt. In August, 1904,—

40 tons were crushed for eight pennyweights per ton,

but it was generally admitted that gold was lost by the battery, in this case. The total output for 1904 is, according to the Warden—

50 tons, yielding 29 oz. = 11 dwt. 14 gr. per ton.

The "schist" bottom slopes at an average angle of 1 in 12 to the west, but there are many variations.

Wainsboro's (abandoned).—Near Carroll's.

There are reported to have been several crushings for five ounces to the load.

Davis's (abandoned).—East of Dequin's.

The main shaft sinking included a considerable thickness of dark carbonaceous and pyritous shale (with fragments of charcoal and stems of plants) just above the wash. The same shale in a claim to the east is said to have been very coaly.

In this shaft there is said to have been two or three feet of "wash," containing large amounts of "pilot stone," and carrying 15 to 17 dwt. of gold per load.

The northern shaft is 115 feet deep.

It is reported that 500 loads were raised, for a yield of one ounce per load.

Potts's.—South of Daintree's Knob.

The shaft is about 100 feet deep, and although on the edge of the Knob, only one boulder of "billy" was found near the surface in sinking. Mr. Potts told me of a thin seam of impure coal which (if not cut in this shaft) he knew to be two feet six inches above the "wash" in one of the abandoned claims in the blue ground to the north-west. The ground worked, chiefly east of the shaft, is 35 feet in diameter.

The "wash" is partly cemented, and all has to be "shot" down. Gold, much of which is fine, is now being got 20 feet north-west of the shaft, on a saddle. There being no gold in the adjacent gutter indicates that it was brought into the "wash" in solution.

The first party working this claim took about a foot of "wash" for an average of 9 or 10 dwt., but the present holder proposes to break down 15 inches, and he hopes to average nearly an ounce to the ton, the pannings-off having shown between three and four grains to the dish.

The general slope of the bottom may be taken as west and south-west.

The bedrock is foliated schist. The foliæ lie practically flat, and are traversed by numerous quartz lenses and iron-stained cracks, up which solutions may have come.

Fitz and Gore's (abandoned).—About five chains south of Dequin's, and the same distance west of Potts's.

The shaft is 105 feet deep.

This was one of the richest of the earlier claims, the yield having been three ounces per load for over a year.

(*k*) HARD HILL LEAD.

The lead takes its name from the "tightness" of the "wash," which, together with the patchiness of the gold and the smallness of the numerous trails, rendered it anything but favourable ground to work. There are many blocks still left. The run continues, as mentioned elsewhere, past Daintree's Knob, and it will, it is confidently expected, be followed out into the Deep Ground to the west or north-west.

There was only one claim at work on Hard Hill at the time of my visit, most of the work having been done during the year 1900.

P.C. (abandoned).—Wells and Joyce here had a small patch which was not traceable into adjoining claims.

Ferguson's.—The claim lies in about the centre of the lead, and has been worked for the last year.

The shaft is 60 feet deep. In the south-western extremity of the workings two gutters, with a westerly run and dip, are being followed, the gold, elsewhere distributed, having apparently been concentrated in them.

The "wash" consists of well waterworn pebbles of slate, and above it is a blue, red, and brown fine-grained sediment. The two feet resting on bottom is a hard cemented ferruginous conglomerate.

As a rule, nine inches of "cement" is taken for crushing, together with three or four inches of bedrock. About 120 tons have, during the last fifteen months, been crushed, for an average yield of 15 dwt. (from 8 dwt. to 30 dwt.) to the ton.

The bottom slopes from 1 in 10 to 1 in 5 towards the south-west.

The bedrock is a light chloritic schist.

(*l*) BLUE GROUND.

All the old claims on the Blue Ground west of Gowrie Creek and north of Daintree's Knob have been deserted. The yields seem to have been below the normal. East of the creek a party (Meyer's) had just bottomed a "duffer." They struck "wash" at a depth of 104 feet, but it was barren.

(*m*) OLD CRICKET GROUND.

This ground, on the western side of Gowrie Creek and to the south-west of Fox's Run, long lay neglected because of the suspected existence in the sinking of a thick bed of "billy," one of the hardest rocks known in mining. The "billy," having been proved to lie off the Old Cricket Ground (to the east), shaft sinking was at once begun, with the results given below. (Plate 8.)

The claims, with the exception of one or two of the earlier ones which proved "duffers," were all in full working order when visited, and offered every facility for an inspection.

The gold from here is rounded when coarse, but when fine it is flaky and generally concave.

Hopkin's.—This claim, lying beside Gowrie Creek, was one of the earliest in the vicinity. It proved a "duffer," but the strata cut in it are here quoted as showing what was expected on the Old Cricket Ground:—

Surface red clay	1 foot 6 inches
Weathered basalt	20 feet
Sand	1 foot
"Billy" (solid)	25 feet
"Billy" (pudding stone)..	10 feet
"Headings" (conglomerate)	6 feet 6 inches
	64 feet

BLACK RIDGE WORKINGS.

Plate 8.

PANORAMA—LOOKING TOWARDS DEEP GROUND ACROSS GOWRIE CREEK.

Soft white decomposed schist bottom.

Yates.—This is the windlass well situated in front of Noonan's store.

The shaft, 69 feet deep, was sunk about five years ago, through basalt (20 feet), "billy," and sand, overlying barren "cement." The sinking took six months. Fitz and party, in 1903, opened out chambers on each side of the shaft, within 10 feet of which a "fall" (fault ?) of nine feet occurs.

Gold was found on a sidling and channel (fault ?), passing three feet from the shaft.

The "wash" at 70 feet west of the shaft contained only four pennyweights to the load. Fitz raised from the chambers, it is said, about fifty-eight loads:—

44 loads yielded	28 dwt. per load.
1 load yielded	13 dwt. per load.
13 loads (the last) yielded	4¾ dwt. per load.

Dixon's (Fraser and Lock).—West of Noonan's store. After having been abandoned, the claim, at the time of my visit (in August, 1904), had been just taken up again.

The shaft is 118 feet deep ("wash" having been cut at a depth of 115 feet). It had lately been bailed and cleaned out, and an attempt was being made by driving to the south-east to cut the old run of gold (worked in a large chamber 25 feet south of the shaft).

In the "wash" in the drive, at 30 feet from the shaft, there is, with a fair amount of quartz, a large proportion of sand, which is considered an unfavourable constituent by the miners.

When first worked, it is understood, ½-dwt. to the dish (2½ oz. to the ton) was obtained south of the shaft.

The bottom is slickensided, and slopes 1 in 1 south-west (in the drive).

The bedrock consists of thinly laminated blue and white chloritic and sandy schists, dipping steeply to the south-west, and containing numerous quartz leaders. Such would be generally considered promising for the occurrence of gold.

Dan Carroll's.—On the northern part of the Old Cricket Ground.

The present working shaft, the second sunk, is 73 feet deep. It is understood that the sinking included—basalt, 20 feet; "billy," 1 foot; and "billy" sand, 12 feet. Chambers have been excavated east and west of the shaft, and a drive has been carried out about 100 feet along the old workings to the south-west, where is the present face. The workings east of the shaft are inaccessible.

There is very little quartz and there are few "pilot stones" in the "wash," which consists practically of schist, often in very large boulders set in clay, and such is generally believed locally to be very favourable ground for the occurrence of gold. Many of the fragments dip to the north-west, but the rule is not universal, even in this claim.

The gold may sometimes in sidlings occur 18 inches above bedrock; and, as it is impracticable to test the whole face as broken down, it is often necessary to risk sending 20 tons to the puddler without knowing for certain whether the contents are payable or not. Prospecting the "wash" here is unsatisfactory, for the additional reason that the gold is "shotty," colours up to 23 dwt. having been found.

About a foot of "wash" and three inches of bedrock are sent to the puddler—the average yield being only five or six pennyweights per load, while the best was 13 dwt. Such a small yield pays, because of the softness of both "wash" and bedrock.

The bottom here is, as a rule, nearly level. The slope of 1 in 5 to the south-west at the present face is believed to be merely the side of a local hollow, for the general slope, as proved by the adjoining claims, is to the west.

The bedrock is soft schist, the vertical laminations of which strike north-east. Owing to its extreme softness, the pebbles of the "wash" have in places sunk several inches into it, and it is, therefore, sometimes difficult to say where the original bottom really is.

Hill's.—Adjoins Carroll's on the south.

From the main shaft the workings extend 55 feet north and south. The present face is about 60 feet south-west of the shaft, and adjoins Cockson's boundary.

The "wash" is composed chiefly of rounded schist pebbles, with numerous "pilots," but very little quartz, and the boulders in the present face are mostly inclined to the south-west. It is richest where "puggy," being poor, as a rule, when sandy or gravelly (as to the south-west of the shaft). Though only the lowest foot or so is auriferous, the conglomerate extends up the shaft for 25 feet. In the northern workings the best gold (¼-dwt. to the dish) was found in "puggy wash" on the western side of a "bar" (the slope of which was 45°); while in the southern workings the richest (three pennyweights to the dish) was found on top of the "bar," and consisted mostly of "specimens" (*i.e.*, gold attached to the original quartz). Unfortunately, I could see none of this "specimen" gold.

The material for treatment consists of nine inches "wash" and four inches bedrock. The output previous to August, 1904, given me by the claim-holders, includes:—

18 loads (of 1¼ tons), yielding	5 dwt. per load.
24 loads, yielding	19 dwt. per load.
19 loads, yielding	19 dwt. per load.
19 loads, yielding	9 dwt. per load.

The last was the total output for 1904, according to the Warden's annual report.

The general slope of the bottom (from 1 in 1 to 1 in 20) is westerly, but there are very numerous rolls, the influence of which is shown by the "wash" being generally poor when the fall is towards the north or east.

The bedrock is foliated schist (on edge), in which occur hungry quartz leaders, often reaching to the "wash," in which in their vicinity there is usually rich gold. The partings in the schist have in many cases distinctly the appearance of fissures, which, however, do not continue into the "wash," at least not more than ¼-inch, for the pebbles have never been affected in the least.

Cockson's.—Adjoins Hill's claim on the south.

The whip shaft is 103 feet deep, and the workings, about 30 feet in diameter, have opened out on the west to Donaldson's and Williamson's boundaries.

The "wash" comprises chiefly medium-sized (two inches to three inches diameter) flat pebbles of decomposed schist, with comparatively few quartz pebbles.

A specimen of the "wash," consisting of waterworn pebbles of schist, with much marcasite in the cementing material, was secured in this claim. Eight months after obtaining it, the marcasite was found to have almost completely decomposed, and not alone had the pebbles fallen apart, but they had become cracked throughout, and covered with a feathery growth of epsomite where had formerly been marcasite. The best gold is discovered on sidlings, and generally more abundantly where the bottom is tinted blue.

On an average six inches "wash" and four inches of bedrock are raised for treatment.

Between the "wash" and bottom is a thin seam of dark "pug," or flucan, which is a strong indication of there having been a movement of the coal measures on the schists. The slope of the bottom is from 1 in 8 to 1 in 12 to the west.

The soft schist (bedrock) is on edge and the laminæ strike northeast.

George's.—East of Cockson's and south of Carroll's claim.

The only shaft on the claim is 75 feet deep, bedrock being struck at a depth of 70 feet, as shown in the following section (for which I am indebted to the claim-holders):—

Soil	2 feet
Decomposed basalt	33 feet
"Billy"	4 feet
Hard "cement"	4 feet
"Pug" conglomerate	27 feet
Schist	5 feet

A considerable area of comparatively poor ground has been worked out along a north and south "bar," south and east of the shaft. At present work is going on about 60 feet north of the shaft.

The "wash" consists entirely of decomposed schist, in a very soft state, and, therefore, suitable for puddling; but, owing to the prevalence of "soapy heads," large masses are liable at any time to fall away from the roof of the workings. The gold is, except on the northern boundary, all fine and flaky, the biggest speck weighing two pennyweights six grains.

The average yield has been seven pennyweights (the best was 9½ dwt.) per load, the total amount of material treated being about 120 loads. During the three months—June, July, August, 1904—there were puddled—

43 loads for a yield of 30 oz., equal to 13 dwt. 23 gr. per load.

The bottom south of the shaft is flat, but north of it the slope is to the west and south.

The bedrock, which, like the "wash," is very soft, is schist, with quartz leaders striking east-north-east.

Reedy's and Williamson's.—South of Cockson's claim.

The main shaft, in the north-western corner of the claim, is 102 feet deep; in the upper part 30 feet of basalt overlying four feet of "billy sand" was pierced. In August, 1904, about one-third of the ground had been cut out.

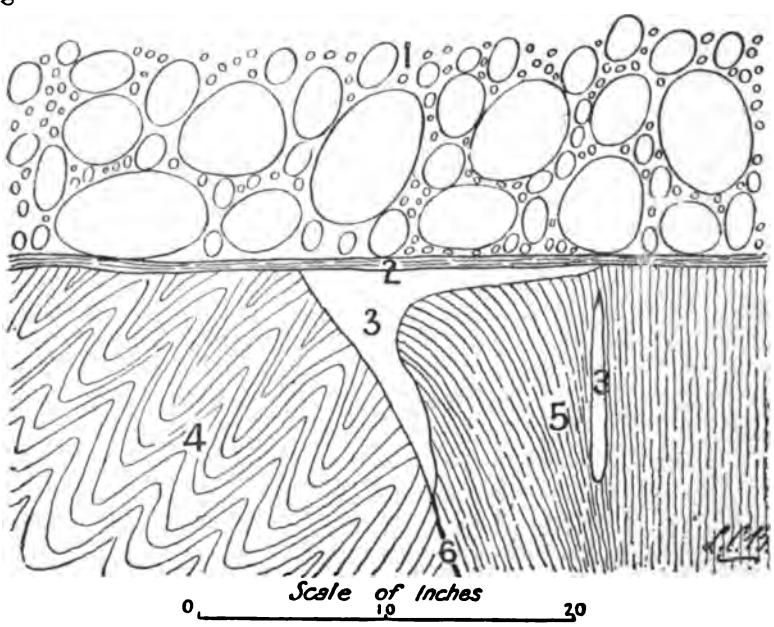

FIG. 1.—LEADER ON FAULT, REEDY'S CLAIM, BLACK RIDGE.

1. "Wash."
2. "Pug" seam.
3. Quartz.
4. Contorted schist.
5. Foliated schist.
6. Fault.

"Mundic" ocurs in the "wash," but it does not seem to have had any beneficial effect on the gold contents, assays made early in 1904 of some of the mineral showing only a few pennyweights per ton. The gold is "shotty," the coarsest slug found weighing one ounce, and being rounded. It is believed to be practically all within six inches of the bottom.

The gold is secured by the removal of six inches of "wash" and three inches of bedrock. During the last twelve months about 300

loads have been raised and treated, for an average yield of one ounce to the load; but one puddler (20 tons) is said to have carried $2\frac{1}{2}$ oz. per load.

The slope of the bottom is about 1 in 15 to the west, throughout the workings.

The bedrock is schist (on edge and slightly foliated), which on exposure to the air swells up (six inches in a night, it is said), becomes contorted, and breaks away. It is thus sometimes difficult to keep the drives open, and two feet six inch props are often embedded to a depth of 18 inches. It has been noticed that flat leaders, connecting with vertical stringers, occur in the schist, beneath the "wash," and above them the gold is always extra plentiful. The only occurrence seen is that given in Fig. 1. The fissure shown is evidently older than the "wash," as is also the quartz, but, this being a line of weakness, the auriferous solutions or the precipitating agents may have risen along it.

The conglomerate here, as in George's claim, forms a very bad roof, necessitating close timbering. The props are spaced three to four feet apart, and laths are carried overhead at the face. The waste material is stacked behind the working face, as in coal-mining.

Donaldson's.—West of Cockson's.

The shaft is 127 feet deep, bedrock having been entered at 120 feet. Work is now going on at 70 feet east of the shaft, in a belt of auriferous "wash," running south-west along the western side of a "bar" 16 feet high. The ground to the "bar," about 100 feet east of the shaft, has been worked out over an area 80 feet long.

The "wash" is known as blue ground, but the pebbles, though less decomposed, are of the same nature as in the shallower white ground, into which, in fact, the blue ground gradually fades. It is said to be "mellow," and likely to be rich when composed of sub-angular fragments of blue schist, while, when the "wash" is well rounded and contains much quartz, it is said to be "hungry" or "drift." Boulders of rotten granite occur throughout the "wash." The "cement" ground at the shaft is reddish, and very hard, carrying about 12 dwt. to the load. The "cement" continues to the north and north-west of the shaft, but, on the opposite side, it is soft, and known as "puddling wash." The gold is "rubbly," averaging $\frac{1}{4}$ dwt. in size, but one ounce colours are occasionally found, and one of 35 dwt. has been reported. The percentage of flaky gold is small, but both "specimen" (*i.e.*, attached to quartz) and fine gold occur.

For treatment four inches of "wash" and four inches to six inches of bedrock are raised. The total output was given me as 230 loads for an average yield of about one ounce per load (of $1\frac{1}{4}$ tons), though running as high as two ounces, so that this must have been one of the richest claims.

A $\frac{1}{16}$-inch layer of rich gold-bearing "sediment" (probably flucan) is to be seen throughout the claim, between the "wash" and bottom. It has much the appearance of a plane of movement. That it is such is

proved by the occasional pockets of "wash" below it (differing from that immediately above), and the masses of crushed schist above it (differing from the bedrock below). One such pocket is shown in Fig. 2. The layer is reported to increase to ½ inch in thickness at the "drops," as should be expected if it is due to sliding of the coal measures on bedrock.

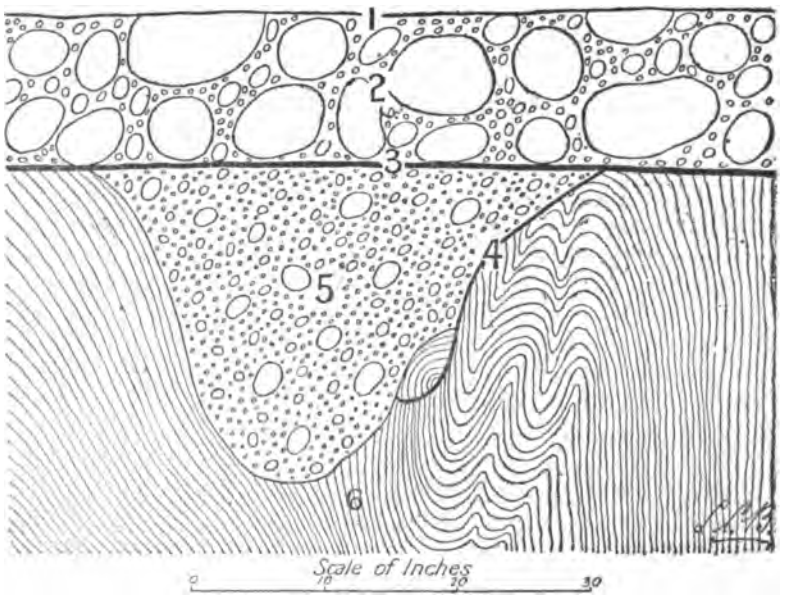

FIG 2.—POCKET UNDER "PUG" SEAM, DONALDSON'S CLAIM, BLACK RIDGE.

1. Roof of drive.
2. Gold-bearing "wash."
3. Gold-bearing "pug"—slickensided fissure
4. Slickenside on bedrock.
5. Sandy "wash."
6. Schist.

The slope of the bottom in the latest workings is 1 in 12 westerly (between west-north-west and west-south-west), but the general slope is to the west-north-west. It is affirmed that after the rise (on the "bar") of 16 feet, above referred to, the slope is very slight for 30 feet, when there is a second rise of six feet to a terrace known as Williamson's. This is looked upon as the most even ground at the Ridge, there being no bumps or pot-holes, and the only falls being from one "terrace" to another.

The schists (bedrock), sometimes very soft, are on edge, and this probably favourably influenced the deposition of gold in the "wash." They are seamed by great numbers of quartz leaders, and, when these project above the bottom, it is found that the gold occurs in the schist as much as six inches below the "wash." The occurrence of dykes is denied.

It has been noticed that in damp weather a few cupsful of water "make" in the shaft bottom, though there is no sign of water at ordinary times. It has, therefore, been concluded that this slight

amount of moisture is always exuding from the quartz leaders in the schist, but in dry weather is evaporated as fast as it reaches the surface. It points to the occurrence of circulating water otherwise unsuspected, which may be even now engaged in enriching the "wash."

The use of ironbark tram rails (1½ inches by ¾ inch), not only for the straights but also for the curves, is interesting from an engineering point of view. The rails are bent into graceful curves, and kept in position by insertion in grooved sleepers. As was remarked, it requires very little more trouble to set them than the ordinary short straights, and this is far more than compensated by the ease of maintenance and running, the trucking from the face to the shaft being always looked upon as one of the most expensive factors in mining here.

Burn's (Davidson's old).— South of Donaldson's.

The main shaft is 127 feet deep. The ground east, south, and west of the shaft has now been practically worked out. The run at present being worked is on a steep fall to the west and north-west, on Donaldson's boundary, north-east of the shaft.

The "wash" is considered "hungry," being mostly well-rounded, with a considerable proportion of quartz pebbles and light-brown rotten granite, but very little schist, and very few "pilots." On the cracks of some of the quartz pebbles are films of marcasite, deposited since the quartz reached its present position, as proved by its sometimes partly encrusting the pebbles.

Only two inches of "wash," with six inches of bedrock is raised from the southern face (for returns of ½-oz. to the load), though more was taken from the northern faces. Burn's output totals—

39 loads, for yields of from 7 dwt. to 10½ dwt. per load.

On Donaldson's boundaries the "wash" is believed to average 13 dwt. to the load.

The bottom is very uneven, in the present face being alternately flat and very steep. The average slope is 1 in 10 (in one place it increased to 45°) to the west, but on the southern face there is one local slope to the east.

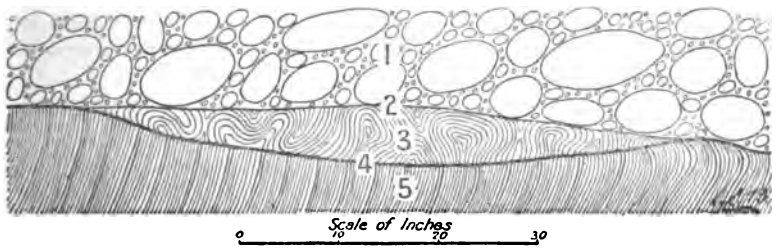

FIG. 3.—SCHIST ABOVE SLICKENSIDED "BOTTOM," BURN'S CLAIM, BLACK RIDGE.

1. Coarse hungry "wash."
2. Original "bottom," no slickensides.
3. Crushed soapy schist.
4. Strong slickenside ("bottom.")
5. Soft blue and white schist.

The signs of movement that has taken place between the coal measures and the schists are very plain. The sketch above (Fig. 3) shows the present slickensided bottom under a small, much-crushed projection of the bedrock (which carries good gold). The movement of the coal measures was, in this case, from west to east, as proved by the bending over of the schists. Very little, if any, movement can, however, have taken place near the north-eastern face now being worked, where there is only occasionally any slickensided surface between the "wash" and bedrock. Slickensided surfaces sometimes glance into the bottom, and the schist above them is then auriferous. This surely points to secondary enrichment of the "wash" as well as of the upper surface of the bedrock.

The soft schist forming the bottom, dipping steeply to the south, and striking east and west, is on edge. It is thinly laminated, white and blue, with numerous lenticular quartz leaders, which, however, seldom reach to the "wash," but when they do reach it, the latter is specially rich in gold.

(*n*) NORTHERN WORKINGS.

These are on the flat on the western side of Gowrie Creek, below (*i.e.*, to the north of) the Old Cricket Ground, and extend for a distance of ¼-mile, with a width of up to ten chains.

"Billy" up to 20 feet in thickness occurred in patches under that part of the flat nearest the Old Cricket Ground.

The old puddler well, a little over seven chains north of Noonan's store, is said to have been sunk through 20 feet of basalt, above 19 feet 6 inches of "billy," and then through "sand" to the "headings" (*i.e.*, the "wash") at a depth of 78 feet. It is reported that a seven ounce nugget was obtained in this claim.

The most northerly holes are in 20-feet ground, consisting of five feet black soil over pipeclay and white clayey "wash," dipping 1 in 6 to the south-west). The schist bottom does not appear to have been reached in the workings.

East of these last a considerable number of shallow holes (eight to ten feet deep) were sunk in 1892 along the bank of Gowrie Creek, but there are no records as to the values obtained. These are connected with Fox's Lead by an area of "surfacing."

(*o*) HILLSIDE CLAIMS.

These claims are on a line, upon the western slope of the Gowrie Creek depression, connecting the workings on the Old Cricket Ground and those on the Deep Ground.

Ford's.—West of Donaldson's.

The shaft is 152 feet deep (on bottom). A very slight seepage was encountered about four feet above the bottom of the shaft, but there was not sufficient water to cause any trouble.

A chamber has been worked out all round the shaft, but most of the work has been to the south-east, the area worked in August, 1904, being 30 feet in diameter.

The "wash" consists principally of well-rounded slate and schist pebbles with little quartz. It is referred to as "puggy," each pebble having a clayey coating, which is probably triturated material due to earth movements. The gold occurs in little "dabs" and is very patchy.

About fifty loads have been puddled for a yield of 7½ dwt. per load.

The bottom is slickensided as a rule, though in some parts it is very uneven. Its slope varies bewteen one in twelve and one in five, the fall on the whole being to the north-west; but at the shaft there is a local slope of 1 in 12 to the east.

The stratification, or rather lamination, of the schists (which are not quartz veined) is, in this claim, generally nearly conformable to the slope of the bottom, and conditions have, therefore, not been very favourable for the retention of gold.

McMillan's.—West of Burn's claim. Work has been going on here since Christmas, 1903.

The shaft is 150 feet deep (to "wash"), and the sinking took six weeks. The run was worked easterly to the boundary, and then in a southerly direction from the shaft, spreading out to the west. The present face is about 100 feet south-west of the shaft, and is being carried forward westwards.

The "wash" is composed chiefly of slaty pebbles, but granite (only slightly decomposed) is very plentiful, and "pilot-stones" are found in great numbers, while quartz, on the contrary, is scarce. The pebbles dip north-west in the present face. The gold is fairly coarse, and is characteristically "ragged" (*i.e.*, sharply angular in form).

It has been found that the lower four inches of "wash," and the upper three or four inches of bedrock carry the gold (which is more plentiful in the latter). The following are the returns to the middle of 1904:—

15 loads yielded	10 dwt. per load
20 loads (from the S.W. drive) yielded...	24 dwt. per load
16 loads yielded	15 dwt. per load
28 loads yielded	12 dwt. per load
Total 79 loads, for an average of	15 dwt. per load

The slope of the bottom is generally westerly or south-westerly.

The schist (bedrock) shows great variety, but laminated white and blue is most common. The dip near the shaft is 45° to the east, but elsewhere, if not contorted, it is nearly perpendicular. Quartz leaders occur in the schist, but they are always barren.

Smith's ("The Fraud").—South-west of McMillan's.

The shaft is 177 feet deep, and was sunk in eight weeks, the strata passed through being pipeclay for 10 feet from the surface, and then "cement" (*i.e.*, conglomerate) to the bottom.

A block of ground, about 30 feet in diameter, has been worked out north-west of the shaft, the present workings running to the east.

The "wash" is chiefly composed of slaty rock and quartz-veined quartzite, with a few quartz pebbles (most of which contain pyrite), and some biotite granite. The pebbles in the faces east of the shaft are inclined, like the bottom, to the west. Thin patches of sooty-black carbonaceous shale (emitting a distinct odour of kerosene when heated in a candle-flame), containing impressions of plant stems, are not uncommon in the "wash," and seem to dip with the bottom. These generally occur above the auriferous portion, and, owing to their fissility and greasy surfaces, often allow the "wash" to slip away from under them or fall away themselves, and they are hence known as "soapy or slippery heads." Other planes formed by fissuring and sliding of one part of the rock upon that adjacent occur not only in the "wash" but also in the bedrock. Water with a sweet taste seeps out of the "wash" north of the shaft, and from it on exposure is precipitated a quantity of red hydrated oxide of iron.

The gold is fine and scaly or flaky, and most of it occurs on the bottom.

The stone for treatment includes six inches of "wash," and from four to six inches of bedrock. The output, in September, 1904, comprised—

46 tons, yielding 32 oz. 10 dwt., equal to 14 dwt. 3 gr. per ton; and 50 tons in paddock, expected to run 14 dwt. per ton.

The Warden gives the total output for 1904 as—

230 tons for a yield of 133 oz., equal to 11 dwt. 3 gr. per ton.

The absence of any "pug" between the "wash" and bedrock is noticeable; and the irregularity of the bottom is considerable, the general slope being westerly—from 1 in 10 to 1 in 20.

Bedrock is hard schist, dipping steeply to the south, as a rule, though in the north-western face, where it has been faulted, the laminations are seen to be both vertical and horizontal. (*See* Fig. 4.)

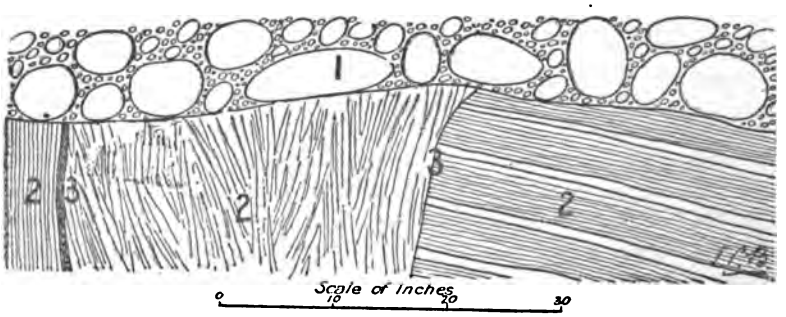

FIG. 4.—CHARACTER OF SCHIST, SMITH'S CLAIM, BLACK RIDGE.

1. "Wash." *3. Fissures and faults.*
2. Vertical, contorted, and gently sloping schists.

A thin leader seemingly intercalated between "wash" and bedrock, such as was spoken of by many miners, was seen here. Close inspection proved that the leader had been originally entirely surrounded by schist, though it may appear to be now in process of formation, the lower part in the schist being solid white, the upper part (under clayey "wash") loose and sugary. East of the shaft leaders one half-inch to two inches thick and six inches long are plentiful.

Moxham's Leap (abandoned).—Ten chains west-north-west of Noonan's store.

This inaccessible shaft is 185 feet deep. Though on the edge of an area of "billy," only boulders of that rock were met in sinking.

Several loads, containing up to 12 or 13 dwt. per load, are reported to have been raised. The "wash" had, however, to be troughed or puddled by the miners themselves, there being no puddling machine at the Ridge when the claim was worked (in 1897), and, under those circumstances, the ground was considered too poor to hold.

The probability is that the ground would now pay to exploit. The deserted claim has, indeed, once been taken up with the idea of trying it, but it was found impossible to carry on operations, owing to the extreme smallness of the shaft, and means were not available for the sinking of a new one.*

(c) Deep Sinking.

The separation of the claims west of Smith's is entirely conventional, the term Deep Ground having been arbitrarily given while miners were hesitating as to whether or not to peg out ahead of McGillivray and sink. To sink a 240-feet shaft and erect a whip meant the expenditure of £15 or £16 per man, in addition to several months of unremunerative work.

(*a*) Older Claims.

The claims begin with Mason's, on the eastern edge of the basalt plateau. In this claim McGillivray first (in 1902) struck payable gold, a run mostly poor, having been followed from the head of Gowrie Creek through the Blue Ground. The mining community seems to have been given to understand from McGillivray's party that their ground was not rich, and that the "run" was making to the north-west.† The Bedfords, in consequence, took up a claim in that direction, and sank

* It was reported in August, 1905, that a trial crushing from the shaft of 75 tons had yielded 22 dwt. per ton.

† Since writing this report, word has been received from Mr. McGillivray objecting to this as "misinformation." He gives as reasons why miners would not work ahead of him the following:—(i.) Water expected; (ii.) Shooting ground in sinking and workings; (iii.) Belief that 1-oz. dirt unpayable; (iv.) Gold spread so that it was impossible to tell which way the "run" lay; (v.) Several miners down shaft; (vi.) Bedfords sank a shaft after compassing McGillivray's ground.

a shaft, but the ground proved poor; and no further attention seems to have been given to the matter till McGillivray took up his present claim on the west of his old one, thus denoting the real direction of the continuation of the run of gold. (Plate 9.)

There is as yet little to form a guide as to how the auriferous ground will continue. The contour of the bottom indicates that depressions from the south and from the east junction on the Eldorado, and that the continuation thence is to the north; nevertheless, it will not necessarily be the case that the richest gold will be found in this depression, for to all appearances it is now on the western slope.

Mason's (McGillivray's Old).—South-west of Smith's.

The shaft is 208 feet deep, ten feet being in bedrock. In sinking, an open crack, dipping steeply to the north, was met in the "cement," but it did not extend into the bedrock. It yielded 300 gallons of water per day, though the water is now 40 feet below the shaft bottom.

The present workings are on the north, and about 30 feet distant from the shaft. They are beside a "bar," which has been traced for hundreds of feet. The main drive runs south-south-west across the dip to below the water-level. McGillivray's workings lie to the west of this, and extend to the boundary of his present claim. Another drive was carried 200 feet to the east of the shaft, apparently in poor ground.

The "wash" is very hard ("cement"); it carries a fair amount of quartz, and a considerable quantity of granite. Long thin flakes of carbonaceous shale occur in it, and, when near the base of the "wash," form "false bottoms" for part of the gold. It is understood that in one place in the old workings a 1½-inch coal seam came down on to the "wash," which was then barren, till the seam again passed into the roof. In the old drive epsomite (hydrous magnesium sulphate) effloresces abundantly from the "wash," which at the same time disintegrates into a fine powder; and these effects are presumably due to the decomposition of pyrite or marcasite in the "wash." Slickensided penthouse "heads" are found all along the main "bar" referred to above. These must have originated in connection with the formation of the "bar," which is really an abrupt fold or fault to the west.

Gold was found, not alone along the crest of the "bar," where two-ounce crushings were obtained, but also, contrary to the usual occurrence, on both sides of it. On the eastern side the "wash" (in other claims not expected to carry more than a few grains) yielded seven pennyweights per load. Gold was followed in a drive down to the 240-feet level, and the "headings" raised from it were, at the time of my visit, being hand-picked and dry-blown, evidently with profit. The gold is not flaky.

Up to six feet of "wash" has been crushed in the past, but the amount taken usually varied between eight inches and two feet, while

Photo., L.C.B. GENERAL VIEW OF DEEP SHAFTS, BLACK RIDGE. **Plate 9.**

just at present only six inches is removed. McGillivray's monthly output during the time he worked this claim is stated to have been—

50 tons, averaging 18 dwt. per ton (from 11 dwt. to 2 oz.).

Mason, taking six feet of "wash" from near the "bar," has crushed—

51 tons, for a yield of seven pennyweights per ton.

By taking only six inches from the ground north of the shaft, a crushing in August, 1904, of—

49 tons yielded 35 oz., or an average of 14 dwt. 7 gr. per ton.

The total yield for 1904 was (according to the Warden)—

81 tons for 54 oz., equivalent to 13 dwt. 4 gr. per ton.

The bottom here is much steeper than in any other claim, the inclination varying from 1 in 6 to 1 in 12 to the west.

The schist (bedrock) is generally on edge, the dip, which is by no means constant, being either to the east or to the west. In the latest workings, to the south-east of the shaft, where there was six feet of very rich "wash" filling a pot-hole, the schists, rather thick bedded and slaty, dip in nearly the same direction as the "wash," but at a greater angle. There are very few quartz leaders, and gold is found in them only when they are cracked on the surface.

Bedford's.—North of McGillivray's.

This claim has, according to the sketch map published with the annual report by the Warden, been taken up by Mason and party, and is also referred to as "Hickey's Claim." As already mentioned, Bedford's shaft was sunk early in 1904, in the belief that McGillivray's run of gold trended northwards.

The shaft (inaccessible at the time of my visit) is 209 feet deep. Drives were carried from it 60 feet south, 40 feet east, 10 feet north, and 20 feet west.

Very little "wash" was found as a result of the driving, the gold, most of it "shotty," varying from colours up to ½ dwt. to the dish (the latter in gutters running north-west). The Warden gives a return, in his annual report, as from Hickey's Claim, of—

15 tons for a yield of 15 oz., equal to one ounce per ton.

This is rather a good return, especially if, as presumed, from Bedford's shaft.

The slope of the bottom is said to have been 1 in 4 to the north-west.

If the above information is correct, there should be every probability of payable gold being struck north-west of this shaft—say towards Chadwick's.

McGillivray's ("Nipper").—West of Mason's. This claim includes ten men's ground.

The shaft is 218 feet deep, and was sunk in eight weeks. The strata passed through include—

Sandy and gravelly sediment	30 feet
"Pug"	15 feet
Blue "cement"	20 feet
"Cement"	35 feet
Blue "cement"	118 feet

Considerable water was met with in sinking the shaft, which was presumably sunk in a comparatively porous portion of the strata, forming a reservoir, for there has not been the slightest trouble with water since opening out. From the shaft a drive was opened to the south-south-west to the boundary (69 feet distant), in order to connect with Fraser's workings, for ventilation. A north-west and south-east run of gold was met just inside the boundary, on the south-western side of which there is a steep fall or roll of three to six feet. This run is now being worked eastwards and westwards.

A black band (which is also found in the claims to the west) in the "wash" about two feet above bottom, was first met in this drive. All the "wash" requires to be blasted down.

At first the claim holders took down 15 to 18 inches "wash," but the average for the year was only seven inches. In August, 1904—

60 tons had been crushed, for a yield of 16 dwt. per ton,

and the Warden's figures for the whole year (1904) are—

349 $\frac{17}{20}$ tons for 261½ oz., equal to 14 dwt. 23 gr. per ton.

During February, 1905—

45 $\frac{19}{20}$ tons yielded 34 oz., equal to 15 dwt. per ton.

The slope along the drive is 1 in 23, but that is diagonally to the steepest, which (averaging 1 in 10), is to the west-south-west, this direction appearing also to be the run of the auriferous ground.

The bedrock consists of bluish-green mica-schist, dipping steeply (1 in 3 to 1 in 5) west and west-south-west. This forms a very rough bottom, and sometimes the quartz veinlets, intercalated in them, and projecting above the general surface, have acted as additional riffles in saving the gold.

Fraser's ("True Blue").—West of McGillivray's. The claim embraces 30,000 square feet (six men's ground). Four men in the face, one at the shaft bottom, and one at the brace (whipman), break down and raise one to four tons a day.

The shaft is 223 feet deep, and was sunk in twelve weeks, with an expenditure per man of £16. To a depth of 80 feet the sinking consisted of variously-coloured sediments (no basalt), below which was a few feet of yellow gravel, and then hard shooting ground (blue conglomerate), the lowermost part of which is the auriferous "wash."

As already mentioned, the shaft is connected with McGillivray's by a drive, in which prospects of up to five and six grains to the dish were obtained. The ground worked out in August, 1904, extended 50 feet east and 50 feet west of the shaft.

The "wash" consists of white quartz and pebbles of green schist, with much granite embedded in a cement of the same colour.

The boulders are seldom more than a foot in diameter, (an exception being just to the north of the shaft, where they are up to three feet long), but the "wash" here, as a whole, is coarser than that in either of the adjoining claims. The boulders seem mostly to be inclined to the north-west, which would indicate that, if alluvial, the transporting stream came from that direction. There are also rather numerous patches and lenses of "tish" (a rock made up entirely of fine or coarse angular fragments of schist, with every appearance of a detrital talus deposit) which is quite barren, though gold occurs both in the coarse "wash" above and in the fine "wash" below it. The thin band of black silt first found in McGillivray's continues in this claim, often acting as a "false bottom," when there is gold above but not below it. Most of the gold occurs attached to the boulders of granite and "black rock" (a kind of "pilot-stone").

Up to three feet of "wash" is taken for treatment, the average being 15 to 18 inches, with three inches (six or eight inches when soft) of bedrock. In their eastern face the miners were just getting on to good gold (two pennyweights to the dish), the "wash" at the same time becoming darker in colour, and carrying a greater proportion of schist fragments. There is in that part also a distinct "dig" or "pug" seam between the "wash" and bedrock. The output includes—

50 tons (from S. of shaft) crushed, in Feb., 1904, for 17 dwt. per ton
56 tons (from S.W. of shaft), in March, 1904, for 16 dwt. per ton
76 tons (from W. and S.E. of shaft), in May, 1904, for 14 dwt. per ton
81 tons (from drive to McGillivray's), in Sept., 1904, 12¼ dwt. per ton

while the Warden in his Annual Report gives the total for 1904 as—

$400\frac{4}{20}$ tons crushed for 460 oz. 12 dwt. = 1 oz. 3 dwt. per ton.

An additional 200 tons were crushed in May-June, 1905.

In a western face, about 40 feet from the shaft, the conglomerates seem to have slid over the schists, shearing off bumps and slickensiding the bottom. The slickensiding is, however, not continuous throughout the claim, and the following example was secured showing how small the movement must have been, and that when shearing did not take place crumpling of the underlying schists resulted:—

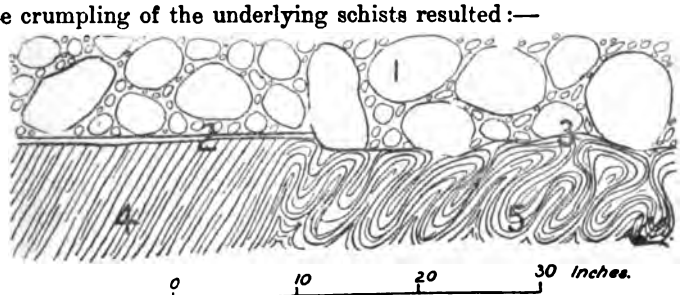

FIG. 5.—SHOWING END OF SLICKENSIDE, FRASER'S CLAIM, BLACK RIDGE.

1. "Wash."
2. Bottom with slickensides.
3. Bottom without slickensides.
4. Foliated schists.
5. Crumpled and slickensided schists.

The inclination of the bottom is, on the average, 1 in 12 to the west-north-west (varying between north-west and south-west).

The bedrock is blue and white granular schist, veined with quartz, generally on edge, and sometimes contorted.

Hennessey's ("Eldorado").—West of Fraser's. This is an area of 30,000 square feet, which is six men's ground.

The shaft is 242 feet deep, and was sunk in fourteen and a-half weeks; explosives, claim expenses, &c., per man, amounting to £16. The following strata were passed through in sinking:—

Black soil	3 feet
Basalt	2 feet
Conglomerate and shale	145 feet
Coal seam (dipping 15° to the N.W.)	4 inches.
Shale and fine loose conglomerate	20 feet
Shale band (dipping S.W.)	1 foot ?
Shale and fine loose conglomerate	46 feet
"Cement"	10 feet

The claim at the end of 1904 was making 60 gallons of water per day.

The first work done consisted in the excavation of a chamber (16 feet in diameter) on the southern side of the shaft, from which a prospecting drive was continued to the south-by-west for 40 feet to what was considered the edge of the run. From their work the miners took it that the run was heading to the south-west. The area worked for the year's crushings is given by the Warden as 70 feet by 60 feet.

The "wash" on the eastern face was very granitic, and very rich in gold, the flakes of which were observed to be, more often than not, on their edges, which would not be the case if they had been deposited from mechanical suspension. The occurrence of "paint gold" in the schists also points to secondary enrichment. The gold in the wash is "shotty." The biggest colour found during 1904 was one of seven pennyweights, but one waterworn slug of 6½ oz. weight has since been found.

For the earlier crushings only six inches of "wash" and six inches of bedrock were saved—sometimes only six inches altogether—but it has since been found that the gold extends for some feet into the headings. The first crushing, in June, 1904, was—

22 tons, yielding 126 oz. = 5 oz. 14 dwt. 13 gr. per ton.

Another, in August, 1904, was—

38 tons, yielding 191 oz. = 5 oz. per ton.

And, in September, 1904—

50 tons yielded 123 oz. 8 dwt. = 2 oz. 9 dwt. 9 gr. per ton.

In consequence of these results, it was decided to put through the 200 tons of "headings" on the surface, and they are probably included in the Warden's total for the year—

316$\frac{1}{10}$ tons, for a yield of 591 oz. = 1 oz. 12 dwt. 18 gr. per ton.

In February, 1905—

75 tons were crushed, for a yield of 23 dwt. per ton.

The strong slickensides on the bottom point to movement of the overlying coal measures having taken place.

Photo., L.C.B.

MADGE'S WHIM, BLACK RIDGE.
SHOWING WINDSAIL.

Plate 10.

In the southern crosscut, the only place that had been opened at the time of my inspection, the slope (rise) increased from 1 in 20 near the shaft, to 1 in 5 at the end.

The bedrock is a blue chloritic slate, very thin bedded in places, and then practically a schist, dipping at angles from 30° to 90°, and sometimes contorted. For four or five inches below the "wash" the rock is softened, and, in that part, gold occurs painted on the laminæ; below that the slate is hard.

Heuat's ("Bantam").—West of Hennessey's. Six men's ground.

The shaft had not reached bedrock when I left the field, but the Warden has since reported that it was struck at a depth of 240 feet (first reported as 237 feet), of which 130 feet was sunk in seven weeks. The strata pierced are as follow:—

Black soil	2 feet
Basalt	50 feet
White gravel	25 feet
Sediments	30 feet
Hard red and blue conglomerate	43 feet
Hard red and blue conglomerate	58 feet
Grey shale (flat) cut in Hennessey's at 170 ft. depth ...	1 foot (?)
Hard conglomerate	

In February, 1905, a drive had been carried from the shaft south-west to Herbert's boundary, 130 feet distant, for the purpose of connecting with his workings, and so ensuring ventilation. The drive proved payable "wash" throughout its length, that at the base of the shaft yielding five grains to the dish.

At the end of September, 1904, the following crushing was reported, three feet of wash being treated:—

30 tons for 42 oz. = 1 oz. 8 dwt. per ton.

The average thickness of "wash" broken down for treatment during 1904 was two feet, and the crushings to the end of 1904 amounted to—

135 tons for a yield of 188 oz. = 1 oz. 7 dwt. 20 gr. per ton.

In March, 1905—

62 tons were crushed for a yield of 66 oz. = 1 oz. 1 dwt. 8 gr. per ton.

Madge's ("Pumpkins").—West of Heuat's. Six men's ground.

The shaft, contrary to all expectation, bottomed at 220 feet, whereas, according to the average dip from Mason's to Fraser's, it should not have reached bedrock for another 100 feet. The sinking (pick work) below the basalt was at the rate of two feet a day, with three shifts; and the total time occupied in sinking the shaft was ten weeks and two days. Madge holds that the contract price locally for sinking a well as deep as his shaft would be £280. Basalt (the only part requiring shooting and timbering) was passed through from the surface soil to a depth of 92 feet. Below that were conglomerates, sandstones, and shales, from the last of which a number of fossil plants impression (mostly of *glossopteris*) were collected by me, but they have not yet been described. The bottom slopes 3 in 5 to the west. Water, at the rate of 40 or 50 gallons a day, came into

the shaft 20 feet below the basalt, but towards the end of the year the amount raised from the workings was 200 gallons. When the mine was inspected, a drive had been opened for 31 feet to the north-north-west, in which distance the fall was four or five feet.

At the shaft bottom there is no "wash," but instead a band of "sediment," dipping less steeply than the bottom, so that it passes into the roof along the drive. A conglomerate bed overlying shale appears about 10 feet from the shaft, but the "wash" did not come in till near the face of the drive, where there is a sudden drop of 1 in 2 to the east by north. This "wash" consists of much rounded schist, and was on the edge of the blue ground. The first prospects of gold were obtained 25 feet from the shaft, and they continually improved till in the face ¼ dwt. to the dish (equivalent to over an ounce per ton) resulted. At this point the "wash" had increased to two or three feet in thickness. The "channel" was therefore presumed to run north-north-west, in which case Heuat's workings would be on the eastern side and Madge's on the western, as indicated by the general contour of the bottom, shown by the depth of the shafts.

During 1904, 14 inches of "wash" was taken, but at the beginning of 1905 five feet was being raised for treatment. Some of the "wash" proved exceedingly rich, five dishes from one part yielding 70 oz. of gold. In October, 1904, the following result was obtained:—

40 tons crushed for 111 oz. = 2 oz. 15 dwt. 12 gr. per ton.

The output for 1904, as given by the Warden, was—

97 tons for a yield of 307 oz. = 3 oz. 3 dwt. 7 gr. per ton.

In February, 1905—

$45\frac{19}{20}$ tons were crushed for 51 oz., equal to 21 dwt. per ton.

Pengelly and Young's.—North of Hennessey's and Heuat's. The claim comprises nine men's ground.

The shaft, which was in process of sinking when I left the field, is 243 feet deep.

The "wash," one foot thick, was not rich at the shaft, but improved southwards, prospecting from ½ gr. to ½ oz. to the dish. Mr. Young has written me that when a superimposed coal seam approaches the bedrock the "prospects" are always poor.* He also records the finding of a waterworn pebble of quartz, weighing 4 oz. 11 dwt., which on dollying yielded two ounces seven pennyweights of gold; and that when the "wash" is heavy the gold, though not necessarily coarse, "weighs well"—that is to say, it is dense and solid.

The Warden gives for the year 1904—

38 tons crushed for 18 oz. = 9 dwt. 11 gr. per ton.

The returns for February, 1905, are—

36 tons for 27½ oz. = 15 dwt. 7 gr. per ton.

---

* Mr. Donald Fraser informs me, however, that a bed of coaly-shale found above the "wash" in the sinking in the richer claims was always absent in the "duffer ground."

In March, 1905—

$76\frac{10}{16}$ tons yielded 74 oz. = 19 dwt. 8 gr. per ton. Value, £4 per oz.

In June—

$102\frac{1}{2}$ tons were milled for 52 oz. 5 dwt., equal to 10 dwt. 5 gr. per ton.

Raynor's ("Last Chance").—North-east of Madge's. There is six men's ground in this claim. Exemption was secured in April, 1905.

The first shaft (in process of sinking when I was on the ground) was abandoned at a depth of 120 feet, on account of the inflow of water. A second shaft, 242 feet deep, was sunk, at a cost of £118 (presumably exclusive of labour). Drives were then opened for 30 feet east and west, and for 33 feet north and south, without striking payable gold. A trial crushing, in February, 1905, gave—

$23\frac{1}{2}$ tons for a yield of $11\frac{1}{2}$ oz., valued at £46.

Chadwick's (abandoned).—Nearly a mile north of Heuat's.

The shaft (inaccessible) is 216 feet deep. No "billy" was struck in it, though there is considerable on the surface in the vicinity. Drives are said to have been opened for 27 feet north-east, and 21 feet east.

There was up to six feet of "wash," agreeing in character with that at the Ridge, and containing great quantities of biotite granite, but colours of gold were found in the 12 inches on bottom.

The bottom is said to have been flat.

The bedrock is green chloritic schist.

(*b*) NEWER CLAIMS.

The following claims have been pegged out on the Deep Ground since my visit, and the particulars have been taken from Press notices, Warden's reports, and other sources:—

Northern.

Croft and Madge's.—West of Madge's ("Pumpkins"). Six men's ground.

Shaft is 204 feet deep.

The wash is freer than usual, and the bottom is soft.

The thickness broken down is two feet, and in April, 1905, the following crushing was made—

62 tons yielded 33 oz. = 10 dwt. 15 gr. per ton.

August, 1905: Taking a big body of stone—

82 tons yielded 52 oz. = $12\frac{1}{2}$ dwt. per ton.

Lloyd's.—West of Croft's. Six men's ground.

Shaft in May, 1905, was 115 feet deep, and was making considerable water. Exempt, June.

Smith and Topham's.—North-west of Finger's. Six men's ground. Shaft in process of sinking; 140 feet deep at the end of May.

Ambrose ("Family Circle").—North-east of Raynor's, and north-west of Pengelly's. Nine men's ground.

The shaft is 245 feet deep. The influx of water amounted to 2,500 gallons per day.

The "wash" struck was unpayable, and a 100-feet drive had failed to find any in February, 1905.

Exemption was secured in April, 1905.

Dequin's ("Perseverance").—North of Raynor's. Exempt in May.

The shaft was 136 feet deep in February, 1905, and still being sunk, the influx of water being 600 gallons per day.

Tasker's ("Endearer" or "Spaniard's").—North of Raynor's. Six men's ground. Exempt in May.

The shaft had reached beneath the water zone at 135 feet, and bottomed unexpectedly at 195 feet depth. It is proposed to continue it, and drive to the "wash." This has been proved to be payable to the dip, which is steep, and to the north-east.

Neight's.—West of Dequin's. Six men's ground. Exemption was obtained in April, 1905.

Sinking stopped in April, 1905, at 122 feet depth, owing to the inflow of water (1,300 gallons per hour), but has since been continued.

Wyles' ("Ruby").—North-west of Neight's. Six men's ground. This is the outermost claim on the west. Exemption was granted in April, 1905.

Water amounting, in February, 1905, to 120 gallons per nine minutes, was met at 95 feet depth. In May 115 feet depth had been reached.

Finger's ("Dolphin" or "Douglas Creek").—North of Dequin's. Nine men's ground. Exempt in June.

The shaft is 256 feet deep—the deepest on the field—and a drive has been opened for 30 feet.

The "wash" contains only fine "colours," so far (May, 1905).

Wolf's ("Daisy").—East of Dolphin. Six men's ground..

Sinking.

Borl's ("Contract").—North of Finger's and Wolf's. Nine men's ground. Abandoned, and secured by a second party (Linton's) in May, 1905.

The shaft had reached a depth of 200 feet in May, and till "wash" is reached no further sinking will be undertaken north of this claim.

Comorty's.—North of Finger's and Dequin's.

No water to 65 feet depth, in February, 1905.

Southern.

These claims are being taken up on the ground between the Deep Shafts and Daintree's Knob. Most of them are reported in the Press* (April, 1905) to have patchy ground, with very irregular prospects, but the gold is thought to be coarser, as a rule, than to the north.

* "The Peak Downs Telegram."

Herbert's ("McLoskey's Mistake").—South of Madge's and Heuat's. Six men's ground.

The shaft is 229½ feet deep, and 80 gallons of water are raised per day.

There is nine inches of "wash" at the shaft bottom, and it is reported to be "good." In March, 1905—

52 tons were crushed for 30½ oz. = 11 dwt. 17 gr. per ton.

Taylor and McMillan's ("Hope").—South-east of Herbert's. Six men's ground.

The shaft is 230 feet deep, and a prospecting drive has been opened.

The "wash" here at the shaft was sandy "cement," carrying only fine colours of gold, but working out from it a 17-dwt. colour was found, and there has been one crushing of 24 dwt. per ton.

McDonnell's ("Just-in-Time").—South-east of Fraser's. Six men's ground.

The shaft is 236 feet deep, the schist being struck at 233 feet. No water was met in sinking.

One slug of three ounces has been found, and three or four of one ounce.

The two feet of "wash" at shaft gave one-ounce prospects. Gold-bearing "wash," one to three feet thick, has now been traced down a long sidling. During the first quarter of 1905—

81 tons were crushed for 173 oz. = 2 oz. 2 dwt. 17 gr. per ton.

August, 1905—

84 tons yielded 106 oz. = 1 oz. 5 dwt. per ton.

The prospects of this claim are thought by some to be the best at the Ridge.

Campbell's ("Moonshine").—South of Fraser's.

Sinking.

O'Hara's ("Blackbutt").—West of McMillan's. Six men's ground. Abandoned, June.

The shaft is 199 feet deep, but was a "duffer"—that is to say, the "wash" there is barren.

Allan's.—The shaft is 184 feet deep, and was abandoned in April, 1904.

Ford's ("Waratah").—South of McMillan's and McDonnell's.

The shaft is 208 feet deep.

The ground is patchy, and, on the whole, there is little gold in the eight inches of auriferous "wash."

Greave's and Meare's ("Brilliant").—South-east of Ford's.

The shaft is 214 feet deep.

In February, 1905, a crushing of—

24 tons yielded 9 oz. 10 dwt. = 7 dwt. 22 gr. per ton;

and in April another crushing resulted in 7½ dwt. per ton.

Donaldson's ("Hopeful").—South of Pugh's. Six men's ground. Abandoned, June.

The shaft is 158 feet deep. It proved a "duffer."

Agnew's ("Eureka").—South of Ford's.

Sinking.

Lyall's ("Excelsior").—South of Greave's. Six men's ground. Abandoned, June.

The shaft is 209 feet deep, the schist being struck at 203 feet depth.

There is little gold in the "wash."

There is reported to be a considerable body of "wash" carrying a fair average gold content; but a trial crushing of—

19 tons gave only 3 dwt. per ton.

The bottom slopes at about 1½ in 1 to the east.

Fogarty's.—This claim includes Williamson's old shaft.

Reported fair prospects.

Pugh's.—South of McMillan's. The shaft is 200 feet deep.

Fair prospects in March, 1905, on edge of lead. One crushing of—

19½ tons has been reported for 10 dwt. per ton.

Cooke's.—A small crushing early in the year yielded 9½ dwt. to the ton.

Jackson's.—South-east of Greave's. Six men's ground. Abandoned, June.

The shaft is 205 feet deep.

Only colours of gold were found in the wash, and, a trial crushing of—

18 tons giving only 4½ dwt. per ton,

the claim was abandoned.

The bottom slopes to the west.

Grace's.—South of Ford's. Six men's ground. Abandoned, June.

The shaft is 207 feet deep.

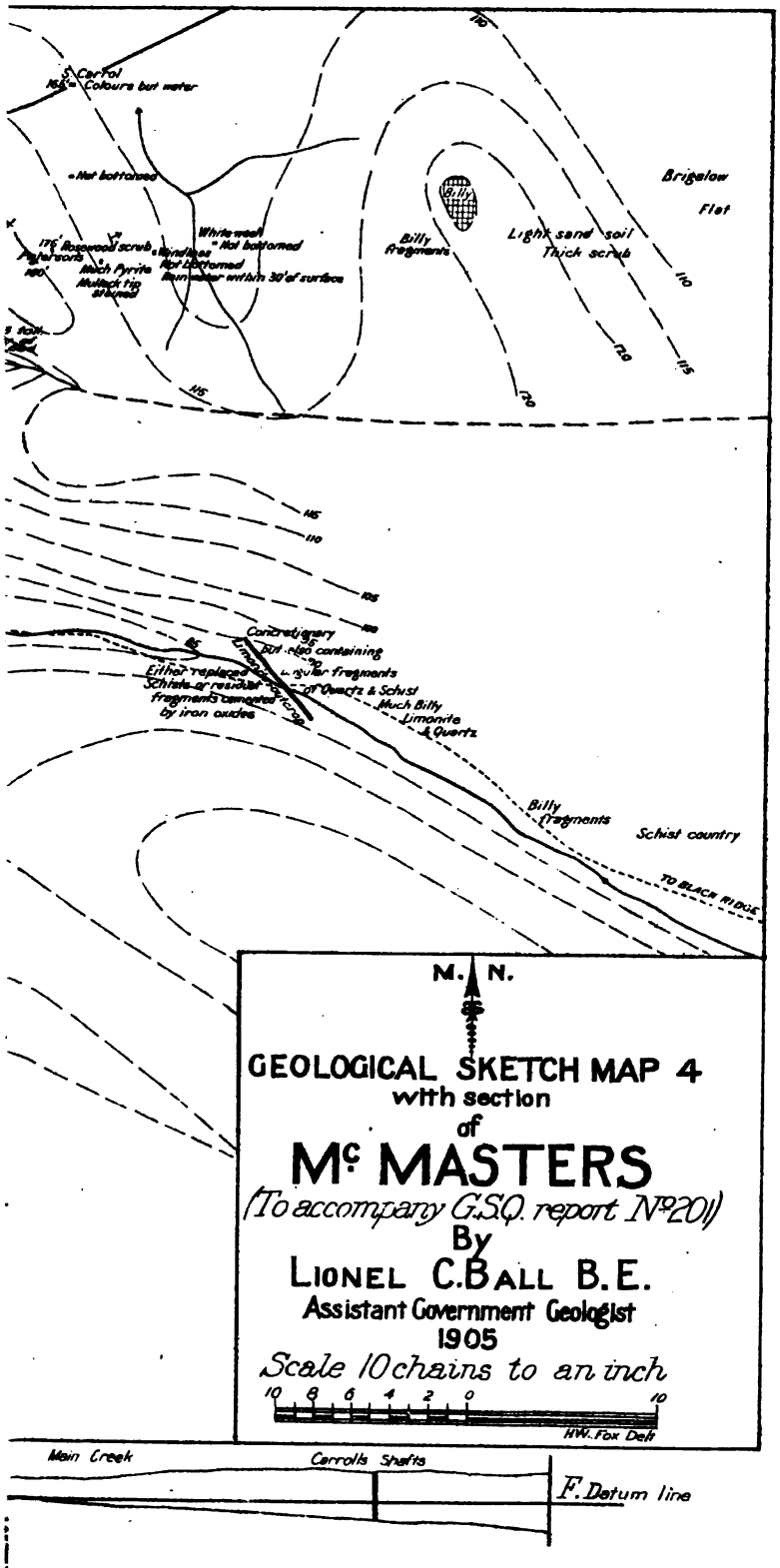
S. Carfol
Colours but water
Not bottomed
Brigalow
Flat
Rosewood scrub
Much Pyrite
Multack tip
Shaded
White weed
Not bottomed
Not Bottomed
Rain water within 30' of surface
Billy
Fragments
Light sand soil
Thick scrub
110
115
120
Concretionary
Soil containing
Angular fragments
of Quartz & Schist
Much Billy
Limonite
& Quartz
Lithol replaced
Schists or residual
fragments cemented
by iron oxides
Billy
Fragments
Schist country
TO BLACK RIDGE
M. N.
GEOLOGICAL SKETCH MAP 4
with section
of
Mc MASTERS
(To accompany G.S.Q. report No 201)
By
LIONEL C. BALL B.E.
Assistant Government Geologist
1905
Scale 10 chains to an inch
10 8 6 4 2 0 10
HW. Fox Delt
Main Creek
Carrolls Shafts
F. Datum line

Photo., L.C.B. PROSPECTOR'S GULLY, McMASTER'S. **Plate 11.**

IV.—McMASTER'S.

The discovery of surface gold in Prospector's Gully, four miles west of Gowrie Creek (at the Black Ridge) followed that at Hurley's in 1864, but a second "rush" to the deep ground north of the creek took place in 1890, in which year nearly all the deeper shafts were put down. Work was abandoned in the deep ground because of the better prospects obtaining at the Black Ridge, but about twenty-five men are still working in the shallower ground.

1. SURFACING.

The workings in Prospector's Gully are about five chains wide, and, to judge by the immense heaps of tailings, the treatment must have been profitable. The ground in fact was specially rich. (Plate 11.)

On the southern side of the Gully is a 15-ft. cap of "cement," which has necessitated sinking to get at the "wash."

The bedrock exposed in the Gully is slaty quartzite.

Lately a little gold has been got in "surfacing" on the southern side of the ridge at the head of the Gully, near Top Camp. The ground—a decomposed basalt soil with lumps of magnesite—quickly deepens to 20 ft. towards the south-east, and the run of gold has been lost.

2. SINKING.

The gold was traced into the basal bed of conglomerate, here dipping eastwards and differing from that at the Black Ridge only in the absence of granite. The overlying sandstone and carbonaceous shales indicate it to be of Permo-Carboniferous age, and Mr. Dunstan has recorded the occurrence of coal in McMaster's shaft.

The "run" was followed to the east round the ridge, with an average width of two chains. In this part, between Prospector's Gully and the main creek (a distance of 35 chains), men are still at work on untouched blocks of ground, of which there are believed to be a number. The ground is richest where the slate is either on edge or else "jumbled."

The "wash" is broken up in troughs at the claim, and the fines are then bagged for transport to water—at the present time, to the Black Ridge.

Otto's.—On the southern side of the main creek.

The shaft, four chains distant from the Creek, is 65 ft. deep, and from it a gutter, dipping easterly, has been followed for 12 ft. to the north-west.

The "wash" contains much quartz-veined quartzite (which is considered a good indication here) and slate, but very little quartz. The gold occurs in patches separated by barren ground. Most of the gold,

which is granular in texture and "shotty" in form, is on the bottom and on crevices and joints, running east and west and north and south, in bedrock.

It is considered that most of the gold is saved by taking from 2 in. to 4 in. of "wash" and bedrock. From the claim on the south-west of Otto's 50 oz. were obtained.

Molloy's (abandoned).—On the alluvial flat on the south side of, and adjacent to, the main creek.

The shaft is 80 ft. deep.

The gold is stated to have been coarse, ranging in mass up to 33 dwt.

For treatment 4 in. of "wash" and 4 in. bottom were raised.

French's (abandoned).—In a similar position to Molloy's, about four chains to the south.

The shaft is 70 ft. deep.

It is reported that twenty loads from this claim yielded 1 oz. to the load.

It is held, and with some reason, that the gold-bearing "run" may yet be proved to continue north-eastwards, from the shallow ground on the southern side of the creek (the claims worked running only slightly north of east). The fact that in Carroll's shaft, 165 ft. deep, lying 10 chains north of Paterson's, gold-bearing "wash," with much water, was struck, is strong evidence in favour of the assumption. The slope of the bottom in that shaft is north-eastwards—*i.e.*, more towards the Seventeen-Mile Well than towards the Black Ridge.

Craven's (abandoned).—North of the creek. This was the next claim towards the dip about which any particulars could be obtained.

The shaft is 105 ft. deep.

It is reported that three loads yielded a total of 15 oz.

Copperwell's.—In this, the adjacent claim on the east, the "wash" struck was barren; but pyrite, both massive and crystallised, is very abundant in the quartz of the "wash" on the tip.

Wainsboro's (abandoned).—Eight chains east of the creek.

The shaft is 146 ft. deep.

The auriferous portion of the "wash," which was brick-red in colour, is said to have been 4 ft. thick in this claim.

Cross's (abandoned).—Two and a-half chains north-east of Wainsboro's.

The shaft is 150 ft. deep.

It is said that, in this claim, the bottom sloped towards Paterson's—*i.e.*, to the south-east—pointing to the main run of gold being in that direction.

Paterson's (abandoned).—On the ridge-top east of the creek.

Paterson's party held this claim for eighteen months. On their abandoning it because of the developments at the Black Ridge, it was taken up by another party, and has since been held by several. The inspection of these workings was rendered possible by the assistance of Mr. Maynard, one of the last to work in it.

There are two main shafts—No. 1 160 ft. deep, and No. 2 (the whip or working shaft 1¼ chains to the east-north-east) 175 ft. deep. Besides these, there is a monkey shaft adjacent to the foot of No. 1 and descending 15 ft. below it. The bottom of the whip and monkey are connected by a semicircular drive, and on the same level a prospecting drive was carried out from the foot of the whip shaft for 70 ft. to the north. At the level of the bottom of No. 1 shaft a large amount of ground has been stoped out, one area extending 30 ft. to the west of that shaft, and another, over a width of 40 ft., to the No. 2 shaft.

The occurrence of efflorescent epsomite, on the strata above the "wash," is very noticeable in descending No. 1 shaft; and at the foot is a large heap of the sulphate and rock powder, which has fretted away from the sides of the shaft. The mullock on the tips also is in an advanced stage of decomposition. Both the crumbling of the rock and the presence of epsomite may be referred to the oxidation of marcasite present in the rock itself.

The "cement" on the lower level is sometimes, at least, tinged red by iron oxides. Only one rich patch of ground, about 25 ft. north of the No. 1 shaft, was struck in this level.

On the upper level the gold was found, three times out of four, above the quartz leaders in the bedrock, and elsewhere along soft thin seams extending for a foot "into the wash," and in places followed for as much as 20 ft. The auriferous ground was very patchy, the best runs being on gentle sidlings.

The fact that, though good gold was found in the "wash" at the top of the "fall" (*see* below) and some gold also at the bottom, the "wash" on its face was barren would indicate that faulting took place either since the gold was deposited in the "wash" or else since the precipitating agent was lodged there.

The gold in the lower workings was coated (probably with iron-manganese oxides), but that in the upper, on the contrary, was quite bright.

The surface of the bottom is very bumpy, though the actual slope, in any direction over large areas, is slight, sometimes scarcely distinguishable in the upper workings; it is to the north-east or north-north-east, and never more than 1 in 8. The general dip in this locality is given as 1 in 11½.

A sudden "fall" of 15 ft. in the bottom can be seen at the monkey and whip shafts, its strike being east-north-east with variations, and its dip 82° to the north-north-west. There is a thickness of several

feet of coloured (blue, black, red, brown, and white) bands of clay, which, when first opened, gave much trouble owing to its plasticity. This has every appearance of a fault plane. All search for any continuation of the fault into the "wash" above was futile; but, owing to the originally loose nature of the conglomerate, it is to be expected that the fault would die out in it, a bending taking place instead of faulting.

The bedrock (schist) seems when first exposed to have been gently folded and fairly massive, but exposure has caused it to split up into thin folded laminæ. "Hungry" white quartz leaders, often strongly ironstained, occur in it, some of them parallel to the foldings of the rock. (Fig. 6.)

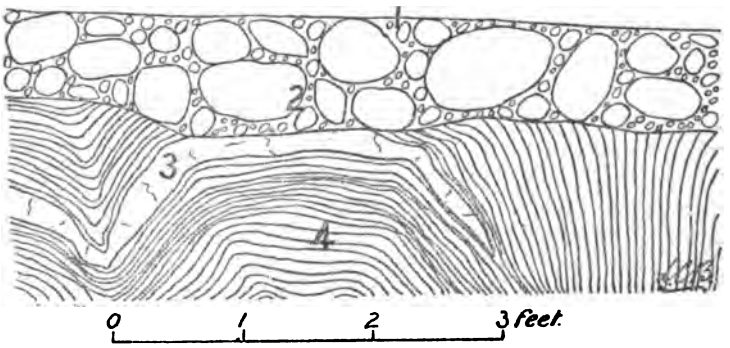

FIG. 6.—QUARTZ IN SCHIST, PATERSON'S CLAIM, MCMASTER'S.

1. Roof of drive. *3. Quartz lens.*
2. "Wash." *4. Schist.*

Otto's (abandoned).—East of Paterson's; the only one of several shafts that bottomed.

The shaft is 120 (?) ft. deep, and a 40-ft. drive opens out from it to the north.

On the southern side of this drive was a high "wall" of bedrock, probably produced by faulting.

The "wash" must have contained a large quantity of pyrite, and yielded five or six pennyweights to the load when worked by Otto, though other parties later secured, he informed me, up to an ounce to the load.

3. NEIGHBOURING WORKINGS.

SCHNUFFLER'S DAM.

Half a mile west-south-west of Top Camp, and seven miles north-north-west of the Venus Hotel.

The workings, practically all surfacing, are just beneath the divide between the Burdekin and Fitzroy waters. The country is highly altered slate and quartzite.

A few men are here in scattered localities making a living by dry-blowing the surface soil.

YANKEE CAMP.

This abandoned ground, which is also known as White Hill, lies, across a black-soil flat about three-quarters of a mile south-east of Top Camp (McMaster's), close to the divide between Bath Creek and Miclere Creek waters.

An east and west line (10 chains long) of surface pits is to be seen at the south, and, from the eastern end, shafts followed northwards a run apparently a chain wide. These are said to have been on good gold for about 10 chains, when, on passing under the black soil (which continues uninteruptedly from here to the Black Ridge), the lead was lost. The Clermont Prospecting Association spent money here in a vain attempt to discover the continuation.

The "wash" consists chiefly of well waterworn quartz, and is remarkable for its freedom from colouring matter. On the surface (the shafts are inaccessible) there is nothing to show the age of the "wash." It differs entirely in general appearance from all conglomerates seen in the coal measures of this district, and looks newer. A similar material is said to have been pierced in sinking Paterson's whip shaft at McMaster's.

It is understood that the gold was found here in association with magnesite. The presence of the magnesite, derived from a former extension of the basalt area, is simply due to its having, owing to its relatively high specific gravity, sunk through the other materials of the soil and "wash."

The bottom slopes northwards, its depth gradually increasing from a few inches to 50 and 60 ft., as proved by the workings.

The bedrock is reported to have been slate containing leaders of quartz.

BLACK JOHNSON'S.

This locality is a little over half a mile west of the Seventeen-Mile Well, and three miles and three-quarters west-north-west of the Ridge.

The present population consists of four men, who are considerably handicapped by the almost continual want of water, that for domestic purposes having to be carried from the Seventeen-Mile Well.

On the left bank of the main creek, which here runs to the north-west, shafts have been sunk 20 ft., in alluvium, to a slate bottom. Away from the creek the ground became gradually shallower, till it was possible to work it by open surfacing. Some of the claims near the creek were profitably held by two or three parties in succession. At the present time the colours found are rather fine, flat, and rounded off, but in the past 5-oz. "specks" have been unearthed.

On the right side of the creek, to the south of the camp, specks of "shotty" gold, up to an ounce in weight, have lately been found by the sole man working there. The gold occurs in shallow trails and patches, chiefly on "bars." "Cement," which here appears to be only

residual schist and quartz with occasional waterworn pebbles, continues south-eastwards up a ridge, for about a quarter of a mile, its thickness increasing from 10 to 20 ft. Gold had been found in the last hole sunk, but the ground could not be tested because of the absence of a water supply.

Beyond these workings there is an outcrop of "pudding-stone billy," separating them from the black soil downs beyond.

An isolated area of surfacing, five chains in diameter, lies on a south-eastern slope one mile south-west of Johnson's Camp, the "wash" consisting almost entirely of angular quartz. One or two men are now going over the old blocks, dry-jigging. Gold must have been brought into the rubble, or into the original schists, in solution, for it has been proved that the area is in no way connected with any other auriferous deposit.

SCRUBBY DAM.

In this locality, two miles west of Black Johnson's, numerous shallow shafts have been sunk by the Clermont Prospecting Association, without, however, discovering payable gold.

SEVENTEEN-MILE WELL.

The distance (17 miles) is from Clermont, and the well is adjacent to the main northern road and telegraph line, three miles and a quarter north-westerly of Gowrie Creek (Black Ridge).

The well itself, 75 ft. deep, has not been sunk below the basalt. Further down the creek, there are reported to be several shafts 60 ft. to 90 ft. deep, which, however, were not seen. The surface formation was "billy," below which were found alternating gravel and fine sediments, but schist bedrock was not reached. They prove the extension of the Black Ridge strata in this direction.

Three miles east of the Seventeen-Mile Well (on the Springs-Miclere Road) the base of the solid basalt is given by Dr. Jack* as only 40 ft. from the surface, overlying 100 ft. of soft red clay (which may be decomposed basalt). A second well, a mile further east, showed the following section, according to the same authority:—

Basalt	40 feet
Mundic (?)	
Decomposed basalt (?)	56 feet.

* G.S.Q., No. 103.

Photo., L.C.B.

GOVERNMENT WELL, MICLERE.

WITH TAILINGS HEAPS IN FOREGROUND.

Plate 12.

V.—MICLERE.

The Miclere workings, called so because they are in the gullies and ridges in the vicinity of the creek of that name, lie nine miles north-by-west of the Springs Hotel and 20 miles north-by-west of Clermont.

The discovery of gold here was made in 1865, but the locality was not held of any account till 1871, since when it has continually supported a number of fossickers. In August, 1904, there were reported to be about sixty men in the district, a few having their wives with them.

Black soil (basalt) downs extend from the Springs to the head of the old shallow workings in Coglan's Gully, about a mile and a half south of Miclere Creek, where schists are exposed. These, Mr. Rands states* form an inlier, six miles long and three miles wide, surrounded by basalt.

The price paid by storekeepers for Miclere gold is £3 17s. per oz.

1. UPPER CAMP.

An extensive area has been rooted over along Coglan's Gully (a small tributary of Miclere Creek), and above and below the Gully on the Miclere itself.

"Billy" occurs most plentifully in the "wash," and the same rock occurs in large outcrops in the vicinity.

The Government Well, on the Miclere, is about half a mile above Coglan's Gully. It has, since 1890, facilitated prospecting and washing of prospects, as testified by the heaps of tailings (7 ft. and 8 ft. high and a chain in diameter), which have been accumulated from countless "pannings-off." (*See* Plate 12.)

Old workings extend above the Government Well for about three miles (to the Twelve-Mile Downs), but there are now very few men on the upper parts of the creek. The surfacing shows the gold to have occurred in runs along and across low ridges. In one or two places, in the alluvial on tributary gullies, sinking has been undertaken, but only to a depth of a few feet.

2. MIDDLE CAMP.

The abandoned workings are reported to extend along Miclere Creek, a total distance of six miles, only two and a half miles of which, having been seen by me, are shown on the accompanying plan. (Fig. 7.)

Boulder Hill.—This slight elevation, lying to the west of Coglan's Gully, is capped by "billy" (*see* under "Billy," Appendix IV.). Gold-bearing ground has been opened on the summit, but the best was found on the north-western side, where a little work is still going on.

* G.S.Q., No. 27.

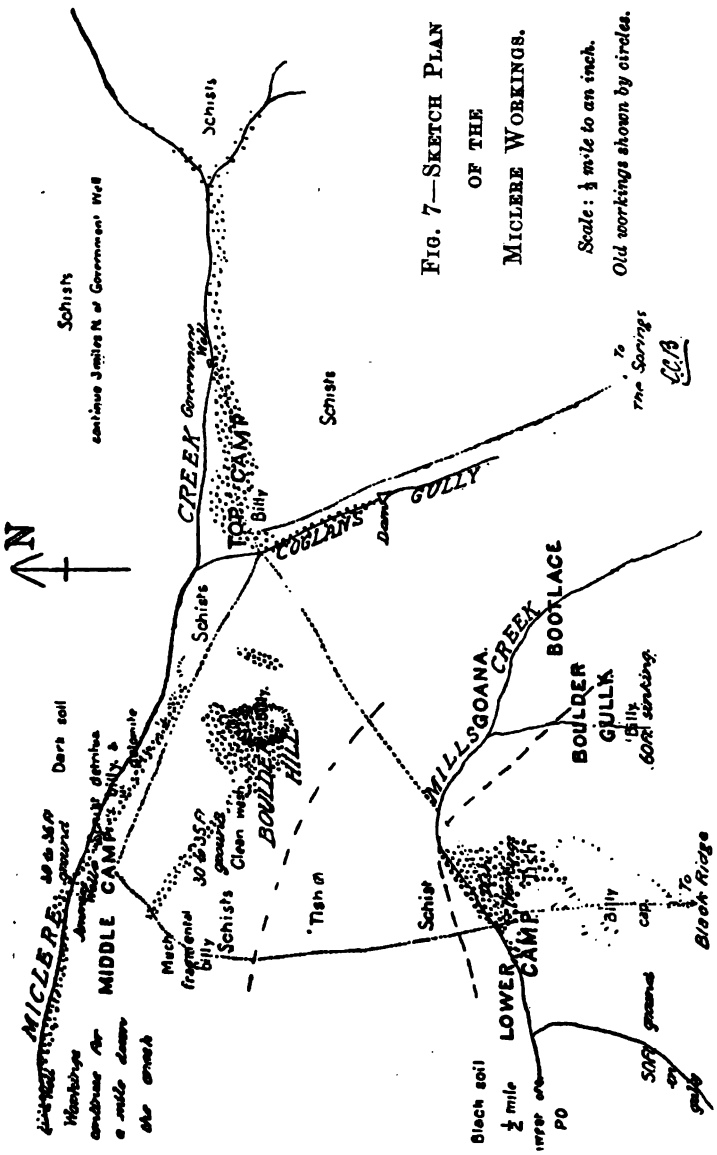

FIG. 7—SKETCH PLAN OF THE MICLERE WORKINGS.

Scale: ½ mile to an inch.
Old workings shown by circles.

The "wash" was up to 12 in. thick, and, over much of the area worked, was covered by a cap of "billy" from 3 ft. to 6 ft. thick. It is reported that slugs of gold up to the size of hen's eggs were found here, and something of the kind would be necessary to induce miners to exploit the ground. The characteristic of the gold shown me is its jaggedness.

The present method of treating the "wash" is by means of dry-blower or dry-jigger, but when the ground was first opened these

Photo., L.C.B. 40 FEET "TISH" GROUND, MICLERE. **Plate 13.**

machines had not been introduced, so that the "wash" had to be carted to water. Extensive trials were made later to puddle the "wash," but it is said that only one pennyweight to the load was saved, which of course did not pay.

From the Hill a narrow lead of "wash," 30 ft. to 35 ft. deep, ran west-north-westwards.

This seems to have been deeper than the ground on Miclere Creek itself.

3. LOWER CAMP.

The workings, at the lower camp on Mill's Creek, about three-quarters of a mile south of Miclere Creek, are of very special interest, as the gold has been traced from residual surface deposits into basal conglomerates (locally known as "tish.") (*See* Fig. 8.) The age of these beds is assumed to be Permo-Carboniferous, because of the occurrence of Glossopteris in similar rocks three miles north of the Miclere.*

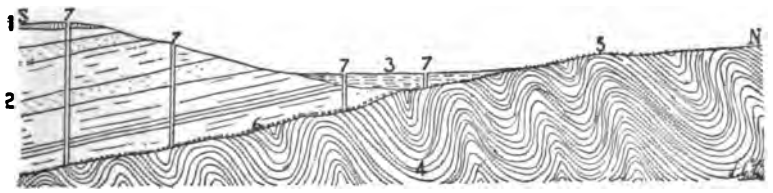

FIG. 8.—DIAGRAMMATIC SECTION, "TISH" WORKINGS, MICLERE.

1. Billy cap.
2. Coal measures (known as "tish" at Miclere.)
3. Alluvium.
4. Schists.
5. Surfacing.
6. Gold-bearing "wash" (¼ mile from edge to outcrop of "wash").
7. Shafts (deepest 120 ft.) showing sinking—in billy and coal measures, in coal measures, in alluvium and coal measures, and in alluvium.

The shallow ground north of the coal measures was worked in 1891, the 30 ft. of sinking being through alluvium and residual schist. Brunny's and Collier's claims were the best in this area. (Plate 13.)

Dr. Jack† describes several claims in which the "tish" (consisting of very large close-packed boulders of slate, quartzite, schist, and granite), separating the upper and lower bed of "wash," varied between 4 ft. and 26 ft.

A large amount of work has been done in the conglomerates, the claims and shafts extending from the creek to the ridge top, about a quarter of a mile distant on the south. It is asserted that the ground was quite dry till flooded from the creek, and that the cessation of operations was due to this accident, the miners having no appliances

* G.S.Q.. No. 176. B. Dunstan.
† G.S.Q., No. 103.

for unwatering the workings. At the present time three claims (old ones) are being worked in the coal measures, but they are near the outcrop—*i.e.*, in 40 ft. ground. It is noticeable that some of the richest claims were, as at the Black Ridge and McMaster's, not on residual ground, but on the conglomerates. It is said that up to 20 oz. to the dish were got in 35 ft. ground, about 20 chains east of the Post Office.

The majority of the pebbles in the basal conglomerate (the "wash") are spotted schist, the spots being due to the incipient formation of secondary minerals. Both "wash" and bedrock are generally bluish-green. The presence of a thin seam of coal in one of the shafts is recorded by Mr. Dunstan.* There was here no defined channel, but gutters in the bottom, locally known as trails, ran north and south, without, however, any persistency. Patches and shoots of auriferous stone were found irregularly over a width of 100 yards.

The gold, as at the Black Ridge, is rounded when coarse, but flat and often eaten through when fine. Mr. Dunstan* speaks of a sample of gold, adhering to a partly water-worn piece of stone, having been found in these workings, and concludes that it indicates that part of the gold "has been deposited, *in situ*, and therefore subsequent to the formation of this as a sedimentary deposit."

From miners on the field it was learned that taking the whole of the ground treated, 8 in. of "wash" was broken down for an average yield of 15 dwt.

The slope of the bottom towards the south-south-west cannot be much more than 1 in 40.

Smith's and Davis' (originally Taylor's).—Ten chains east of the Post Office.

The shaft is 35 feet deep; the sinking comprised alluvium, to 12 feet depth, and, below that, coal measures. The only workings open to view are the two shafts and a 30-ft. drive connecting them.

The "wash" contains a noticeable proportion of granite. In it "colours" of gold have been found, for as much as two feet from bottom. Most of the gold, however, occurs in crumpled bedrock within six inches of the "wash." A gutter in this crumpled rock, on the south side of a rather persistent leader, is now being followed to the west. The finer particles of gold are flat and granular, the larger rounded (or "shotty"), but even then not solid, and, therefore, said to not weigh well, or, at any rate, not as well as appearances would indicate.

The slope of the bottom, which is not slickensided, is variable (up to 1 in 20), but it is generally to the south.

Bedrock is formed of sandy schist, sometimes, though not often, on edge.

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* G.S.Q., No. 176.

The treatment of the auriferous "wash" consists in breaking it up in troughs with iron-shod beaters; picking out the coarser pebbles by hand; bagging and wheeling the "fines" to the well; and there washing either in a wet-jigger or in a dish.

Madge's (abandoned).—A quarter of a mile south of the outcrop.

A large quantity of biotite-granite is here found in the "wash," together with numerous "pilots." The "wash" differs from that at the Black Ridge only in the greater proportion of granite which it contains, and in the more perfectly rounded condition, more spotted character, and better state of preservation of the boulders, the last of which is probably due to the cementing material. The gold was coarse.

It is reported that the output included—

100 tons, yielding 447 oz. of gold = 4 oz. 9 dwt. 10 gr. per ton,

and the "headings" have been washed and dry-blown over and over again.

Unnamed (abandoned).—Near the ridge top, south of Madge's, and 50 ft. above Mills' Creek.

The shaft is believed to be 120 ft. deep. The deeper part of the sinking must, to judge from the tip, have been in a bed of cemented, angular quartz and schist (such as would be called "tish" at the Black Ridge). Only a few inches of it were auriferous, but four inches of "wash" and four inches of bedrock had to be taken up.

The bedrock is reported to have overhung the "wash," in one place, forming a cliff running about south-east. This was most likely a fault plane.

4. Goana (abandoned).

These workings are on Mills' Creek, half a mile above Lower Camp, the creek itself between the two places being non-auriferous. This place, as well as Bootlace and Boulder Gully, could not be visited in the time allowed me.

5. Bootlace (abandoned).

Some "surfacings," about a quarter of a mile above Goana, and also on Mills' Creek, are known as Bootlace.

6. Boulder Gully (abandoned).

Boulder Gully is one of the southern tributaries of Mills' Creek. A small "rush" had lately taken place, but, owing to the immense "billy" boulders on the surface, little work had been done to prove the "wash." The sinking is said to reach a depth of 60 ft.

7th June, 1905.

APPENDICES.

Appendix I.

ALLUVIAL WORKINGS NOT INCLUDED ABOVE.

1. VENUS.

The Venus Hotel, a well-known centre, is situated on the right bank of Bath Creek, 10 miles north-west of Clermont.

I. Venus Flat.

Gold was discovered here in 1902, but work has now practically ceased. The ridges and gullies, across the Flat from the hotel, have been worked, and the waterlogged "wash," under the flat in front of the hotel, is believed to contain three or four pennyweights of gold per ton. Some twenty-five years ago a narrow lead was followed westwards for 15 chains behind the hotel, the gold being then lost in "cement" (conglomerate).

The Venus Flat workings, a quarter of a mile wide, pass on to the ridge-side west of the flat about three-quarters of a mile south-east of the hotel. In these is exposed a similar occurrence to that at the Springs and Black Ridge, there being 5 in. of cement-like "wash," which increases in thickness up the ridge-side to the south-west. South of the main area worked on the ridge a narrow lead was followed down a gully to the road, the depth of "wash" gradually increasing. Below this the main lead on the Flat has been followed down for a mile, the sinking rapidly increasing to 40 ft.

Though a large amount of work has been done here, the results are understood to have not been altogether satisfactory.

II. Mount Walker.

A mile north-west of the Venus Hotel.

A narrow east-and-west belt of "tish," on the southern slopes of the mountain, is now being prospected. The sinking is from 15 to 30 ft.

The "tish" consists of large angular boulders of schist, resting on a rough bottom of mica-schist. The gold is very coarse.

III. Old Four-mile Lead.

These old workings are a mile and a quarter west-north-west of the Venus Hotel.

The lead was traced southwards, from Commissioners' Flat onto the ridge, where it passed under "cement"—*i.e.*, Permo-Carboniferous

conglomerate. The main run was very rich, 70 oz. to the bag having been obtained, but the miners now in the 60 ft. ground are earning only "tucker."

The sinking on the ridge top is 25 ft.; the bottom rolls and the gutters run south-east. Miners, now reworking the old claims, are tearing up 3 in. of the old bottom, the gold in which was overlooked by the men who first held the ground.

This belt of "cement" is believed to continue south-south-eastwards to the Native Bee workings.

Wall's.—One mile west of the Venus Hotel. This is one of the most southerly claims on the Four-Mile Lead.

The shaft, 75 ft. deep, was sunk thirteen years ago.

The "wash" is blue "cement," similar to that at the Black Ridge, and dipping north-east. It requires shooting.

Gold occurs on a "false bottom," and is just as good 2 ft. above as on bottom, the returns varying from "very poor to wages."

Russian's.—About one and a-half miles to the south-south-east of the above.

Shaft is 112 ft. deep.

The "wash" here is poor, but the ground is well worth prospecting.

2. HURLEY'S.

"The cement lead mostly occupies the caps of ridges. . . The hard cement or conglomerate of which it is formed dips at an angle of about 30°, and, although the outcrop has been well worked over, very little has been done below the surface on account of the difficulty in working the deposit. Boulders, tons in weight, occur in it most irregularly, and consist of quartz, quartzite, sandstone, and slate, some of which bear a striking resemblance to the sandstones and quartzites of the "Star" beds of the Drummond Range to the south-west.

"It has not been ascertained to what depth the conglomerate extends. . . . Tests have been made of the conglomerate to ascertain whether battery treatment and amalgamation would be successful, but so far the results have not been sufficiently satisfactory to continue the work. The amount of stone available, which is said to carry a few pennyweights of gold, is enormous, and possibly other methods of treatment might meet with more success."*

It was understood that several men were dry-blowing in this district, but my time limit unfortunately did not allow me to visit the locality. The above quotations are given because of their bearing on the operations at the Black Ridge.

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* G.S.Q., No. 176. B. Dunstan.

3. APSLEY.

At the White Gates, on Apsley Creek, rough surface gold, in waterworn "wash," was found and worked five years ago.

In June, 1904, a small rush took place at a locality on the north side of Apsley Creek, about four miles north-north-west of Clermont. In July, there were about twenty men at work, though in the previous month there had been over sixty, and a few months later the ground was deserted.

The smallness of the yields and the limited width of the auriferous ground, together with the clayey nature of the "wash," were altogether opposed to this proving a payable or permanent run, but, the sub-basalt (?) "wash" to the north of the workings is worthy of further trial.

Besides the P.C., there were seven claims on the east and three claims on the west.

Prospecting Claim.—Four shafts had been sunk, proving the run of gold-bearing ground, two to eight feet wide, to continue east and west (with slight variations from these directions).

The auriferous material consists of angular quartz and schist, embedded in mottled red and grey clay, and is evidently residual from the denudation of the schist country.

An average of 9 in. to 12 in. of "wash" is broken down for treatment. It is believed to carry from ½ oz. to 1 oz. to the load, and is richest where the run is narrowest. The following is the result of treatment:—

2 loads for ½ oz. to the load.
2 loads for 1 oz. to the load (including a 28 dwt. speck).
2 loads for ½ oz. to the load.

No. 3 East.—The following trial has been obtained from this claim:—

2 loads puddled for 13½ dwt. per load (including one 19 dwt. "colour.")

The "wash," being clayey and damp, has to be dried before being broken up. It is, therefore, spread out on the surface and dried by burning brushwood upon it. It can then be readily "troughed," previously to puddling or dry-blowing.

No. 4 East.—Jack and party in this claim got 5 dwt. in prospecting, and puddled:—

2 loads for 2 dwt. to the load, and
2 loads for 3½ dwt. to the load.

Such being unremunerative, the claim was abandoned.

No. 5 East.—

4 loads puddled for 3 dwt. to the load.

No. 7 East.—The shaft is 72 ft. deep.

The "wash" is barren. Bottom dips 1 in 4 to the north. An abandoned shaft, 45 ft. deep, 400 ft. north of this claim, is on true waterworn "wash," which is, however, barren where tested.

Photo., L.C.B. WILD CAT LEAD, CLERMONT. **Plate 14.**

No. 1 West.—

1 load for 13 dwt.
2 loads for 6½ dwt. per load.

No. 2 West.—

2 loads for 15 dwt. per load.
2 loads for 4 dwt. per load.

4. SEVEN-MILE (Copperfield-Aramac Road).

The discovery of gold at this spot was reported by C. Voinech (who had been receiving assistance from the Clermont Prospecting Association) early in August, 1904. As shown below, there is here no sign of any lead, the gold derived from quartz leaders in the schist having been simply concentrated in residual *débris*. In consequence, the locality was soon deserted by all except the prospectors, who have since reported finding more promising ground to the north, but the scarcity of water in the vicinity is retarding operations.

Prospecting Claim.—In August, 1904, six shafts had been sunk, the sinking including 15 ft. of angular blocks of schist in clay.

From the main shaft, 32 ft. deep, drives had been carried 5 ft. north and 20 ft. south (to the second shaft), from the former a crosscut running 6 ft. to the west, and from the latter one 12 ft. to the east. From the work done, the auriferous ground seemed to run north-westwards.

The "wash," similar to the sinking, but finer, is 6 in. to 12 in. thick. It contains waterworn gravel, but is a residual deposit. The gold occurs on sidlings, and is irregular in size (up to 3 dwt.), but none of it is "fine."

In August, 1904, a small load yielded 18 dwt. of gold;
In September, 1904, 4 loads were washed for 4 oz. 15 dwt.; and
In October, 1904, 11 loads were washed for 16 oz. 17½ dwt.

Bottom slopes north-west, but is very irregular.

The bedrock is schist.

No. 1 South (Mulholland's).—South-south-west of the P.C.

Bottom was struck at 30 ft. depth, but not a "colour" of gold was found.

Two claims were being worked ahead on the north-east, but had not bottomed.

5. WILD CAT.

The Wild Cat Lead, now almost abandoned, was one of the richest and most continuous in the vicinity of Clermont. It lies just south of the township.

At the time of Mr. Dunstan's visit the shafts were inaccessible, and therefore occasion was taken by me to inspect one now in use.

The result was the observation of faulting of both bedrock and "wash," with apparently most favourable results on the auriferous contents of the latter. (*See* Figs 9, 10, and 11.)

Hopkins' (originally Baker's).—At the junction of the Kitten and Cat Leads.

The present working shaft (A) is 60 ft. deep; two others—(B) 22 yards to the south-south-west, and (C) 47 yards to the south by west—have been sunk on the same north and south "bar"; and a fourth—(D) 85 ft. to the south-south-east—alongside it. These old workings have been reopened, and the "headings" of both the Cat and Kitten "wash" are being broken down for treatment.

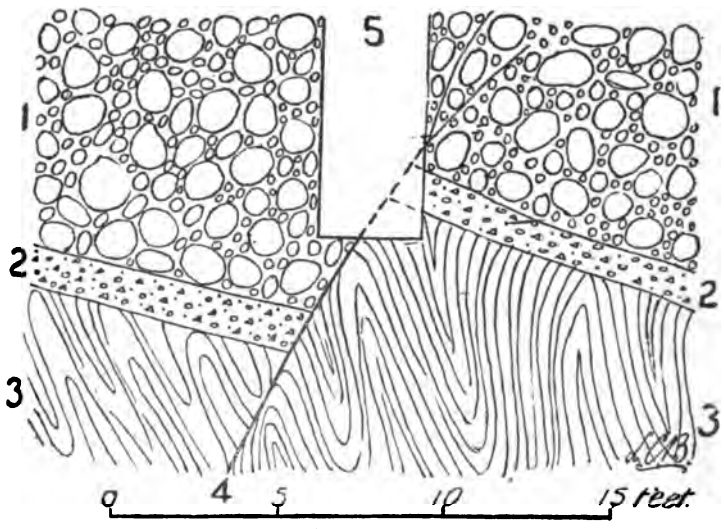

FIG. 9.—SKETCH SECTION, AT SHAFT C, HOPKINS' CLAIM, WILD CAT.

1. Cat "wash" and "headings."
2. Kitten "wash."
3. Schist.
4. Fault in schists, passing into "wash."
5. Shaft C.

Two faults can here be seen, not alone in the schist bottom, but also for 3 ft. above it in the "wash," in which they branch and die out owing to its having yielded to form a monoclinal fold, but, for the distance given, they are strongly marked, vertically slickensided, and manganese-stained. One strikes north-east (on the average), dipping from 45° to 70° to the north-west, the amount of throw varying between 5 ft. and 8 ft. The other strikes north-north-east, and dips up to 80° to the west-north-west, the amount of throw being generally between 2 ft. and 4 ft., but increasing to 8 ft. towards the south. On the fault is a band of sandstone ("sediment"), but enough was not exposed for its nature to be ascertained. The two faults junction at the main shaft, and it is along them and about their

intersection that the "wash" has proved richest, enabling more than double the usual thickness to be successfully treated.

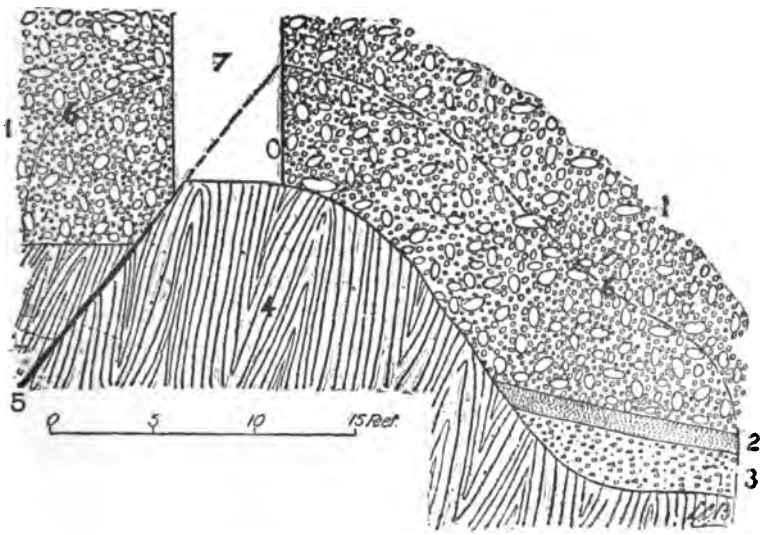

FIG. 10.—SKETCH SECTION AT SHAFT B, HOPKINS' CLAIM, WILD CAT.

1. Cat "wash" and "headings."
2. Sandstone.
3. Kitten "wash" (lower half auriferous.)
4. Schists.
5. Fault in schists, passing into "wash."
6. Dotted line, showing roof of workings.
7. Shaft B.

It is important to note that there is said to be an 8 ft. or 9 ft. wall between the Cat Lead (coming from the south), and the Bower Bird Lead (coming from the west), which have been mapped as branches of of the same lead, though some miners who worked in them believe them to be distinct. This "wall" may have been caused either by a washaway or by faulting.

Further, the frequent use of the term "bar" in miners' descriptions of abandoned workings at the Black Ridge, McMaster's, and Miclere acquires an additional importance when it is considered that the "bars" may have been produced by faulting, with considerable effect on the gold contents of the "wash."

Another interesting feature is the occurrence of two distinct layers of auriferous wash—the Kitten Lead, which comes from the south-east, and the Cat Lead, which comes from the south and overlies the former for 100 ft. north of Hopkins' claim.

The "wash" of the Kitten, 2 ft. to 6 ft., and even 15 ft., in thickness, contains big schist floaters, with some rounded quartz, and it generally resembles that known at the Black Ridge as "tish." It may, therefore, be of Permo-Carboniferous age. At Hopkins' shaft (A) the "tish" is overlaid by barren white waterworn gravel.

The auriferous part of the Cat seldom exceeded 3 ft. in thickness in this claim. It consists of waterworn pebbles. The workings on it keep closely to the two faults referred to.

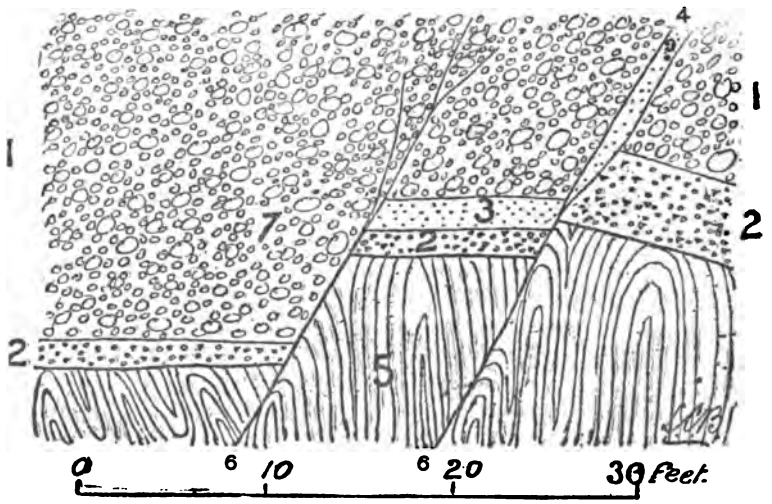

FIG. 11.—SKETCH SECTION ACROSS STEP FAULTS, NEAR SHAFT A, HOPKINS' CLAIM, WILD CAT.

1. Cat "wash" and "headings."
2. Kitten "wash."
3. Sandstone.
4. Slickensided sandstone.
5. Schist.
6. Faults in schists, passing into "wash."
7. Dotted line, showing extent of workings.

6. COPPERFIELD.

The township of Copperfield lies four miles south of Clermont.

"Rich patches of gold from a small hill; one man got 100 oz. in a foot or two of ground."*

A few dozen men are now working with dry-blowers at scattered points in the vicinity of Copperfield. Several men are dry-jigging the red soil, on the point of a spur, within half a mile and to the north-east of the township. These surface workings are near a number of abandoned shafts, in 40 ft. to 50 ft. ground, about which, on a claim known as the Little Wonder, the surface was also exceedingly rich.

* G.S.Q., No. 27. William H. Rands.

Appendix II.

REEFING.

(A) North-west of Clermont.

Pioneer.—Ten miles west of Schnuffler's Dam, 14 miles north-west of Blair Athol, and 25 miles north-west of Clermont. This is the P.C. of the Western district. From Mr. Madge, who holds the ground and employs two men on the claim, the following information was obtained:—

There are five parallel reefs within a distance of 600 ft. The northern reefs dip steeply, and have not been tried.

Over a distance of 300 ft. the outcrop of the Pioneer reef has been removed and crushed. The three shafts are 40 ft., 80 ft., and 112 ft. deep, the first two being 35 ft. apart, and the second two 100 ft. apart.

(*a*) 112-ft. shaft.—On the 50-ft. level is a 60-ft. drive to the north, and at 80 ft. depth is another, from which stoping is now being carried upwards.

The reef, in this shaft, varies from nothing up to 10 in. in thickness. It is vertical to 100 ft. depth, but is now slipping off with the country, which is very hard.*

During the first half of 1904—

28 tons were crushed for 2 oz. 3 dwt. per ton.

(*b*) 40-ft. shaft.—This was sunk three years ago. In it the reef passes into the country to the south at 25 ft. depth.

(*c*) 80-ft. shaft.—This is to be used for future exploitation.

Western.—The following information was obtained from Mr. Small, the former holder of the ground:—

The workings lie 600 ft. north of the Pioneer.

The shaft is 80 ft. deep and underlies 45°.

The reef runs a little north of west, and dips south, while the country dips south-west. It pinched at 80 ft. depth, though the walls are still 2 ft. 6 in. apart.

The output is—

12 tons treated at Clermont for a yield of 2 oz. to the ton.

With cartage to Clermont, costing £2 10s., this scarcely paid expenses.

Mount Walker.—About a mile north-west of the Venus Hotel. Near the summit of Mount Walker a leader, underlying west, has been worked to 40 ft. or 50 ft. depth in sandy slate country. The ore was very rich, but the shoot was only the size of the shaft and cut out at the bottom.

Two or three other leaders have been trenched, but nothing permanent has yet been found.

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* Mr. Dunstan describes the rock as felspathic slate.

(B) South of Clermont.

Skelton's and Whelow's ("New Idea").—Four miles east of Caldwell's battery at Copperfield, and 3½ miles south-south-east of Clermont.

The reef has been trenched for 10 yards, but as it pitched westwards, two windlass shafts had to be sunk about 10 yards apart, the eastern being 51 ft. deep and the western 63 ft. In the latter the shoot was struck at 33 ft. depth. There are drives, 8 ft. west and 12 ft. east, at the bottom of the western shaft; and an 8-ft. drive to the west at the bottom of the eastern.

The average width of the reef, which dips 40 in 1 to the south 10° west, is 3 in., but it generally consists of branches, including schist, so that up to 5 in. are separated for crushing. Leaders, sometimes carrying gold near the reef, pass into the country on the north. The reef is not slickensided, though the footwall breaks away well.

At 60 ft. depth, in the western shaft, a slickensided fault, dipping 40° to west-north-west, throws the leader 4 ft. to the south, but it is understood that quartz continued along the fault. The quartz must therefore be younger than the fault. The stone was especially rich where the leader lay up against the fault. To the east of the fault the quartz gradually thins out, and, in the present face 12 ft. from the shaft, it is only 2 in. thick, though carrying good gold. The difference between the quartz east and west of the fault is probably due to unequal weathering and leaching.

The quartz in the paddock contains plentiful inclusions of schist and siderite on cracks. It appears to be of the usual segregation type characteristic of schist country. The visible gold is all in the form of knife edges and wedges, and occurs in the whitest quartz. Very fine gold also occurs in the siderite. Almost every fragment on the heaps carried visible gold.

The following is the output:—

5 tons (from the trench itself) yielded 7 oz. of gold,
12 tons (from old shaft at western end of trench) yielded 28 oz. gold, one specimen, 1 lb. in weight, yielding 3 oz.

In the western shaft, half a ton of three or four ounce stone was got in the sinking; and 8 lb. of stone, from 60 ft. depth, yielded 24 oz. gold. At the time of my visit the miners were getting good prospects in the western workings. A crushing (including 23 oz. dollied), in August, 1904, of—

8½ tons yielded 108 oz. 2 dwt. = 12 oz. 14 dwt. 8 gr. per ton.

A later crushing in the same year was—

9 tons, yielding 76 oz. = 8 oz. 9 dwt. per ton.

The schist dips 40° to west-north-west.

A shaft, a chain west of the western shaft, struck only small leaderlets in the schist.

Crane's.—Adjoins Skelton's on the north-north-west.

This leader may possibly be a continuation of Skelton's. It has been worked over a distance of a chain, but is now flooded below 15 ft. in the main shaft. A western shaft lies 10 ft., and an eastern 12 ft., from the main one.

In the main shaft, the leader was 6 in. thick to 20 ft. depth, and is reported to be a foot thick thence to 30 ft. depth. In the eastern shaft, the leader is 2 in. thick, but it is increasing westwards and underfoot; and there is also a leader within the hanging-wall. It dips about 85° to the north, while the country dips to the north-north-east. In the bottom of the western shaft is a bluish quartz, probably forming a separate lens to that in the eastern shaft.

Two crushings were obtained from the main shaft—

13 tons for 3½ dwt. gold per ton; and
5 tons (March, 1904) for 1½ dwt. gold per ton.

Christmas Hill (abandoned).—Two chains north-west of Craven's. This reef was worked twenty-five years ago, and it is said 3-oz. crushings were obtained.

The reef runs east and west, and dips to the north.

Peterson's (Old Mystery).—South of New Idea.

The whole of the ridge-top hereabouts has been trenched and sunk on. The main shaft, about two and a half chains west-south-west of Skelton's, is 15 ft. deep.

The stone, of which 2 tons lie at grass, is whiter than Skelton's.

A second abandoned shaft lies a chain and a-half south-west of the above, on a vertical east and west leader, which has been open-cut for about 40 ft. This is perhaps a branch of the old Victoria reef (worked to the west). In addition to this, several small and not quite parallel leaders have been trenched to 6 ft. or 10 ft. depth.

A chain or two to the south of these workings is a small area of "surfacing," though the soil in the neighbourhood of the known auriferous leaders has not been found worth treating. This indicates the possibility, remote perhaps, of the gold in the surface detritus having been precipitated from solutions derived from the schists, in places where there happened to be no precipitating agents in the schists themselves. It is difficult otherwise to account for the non-coincidence of areas of auriferous surface detritus and auriferous quartz leaders.

Mystery No. 1 West.—This ground was held during 1903, but abandoned in 1904.

The workings include a 43 ft. drive to the east and a 16 ft. drive to the west from the shaft.

An east-north-east and west-south-west slide, at the north-western end of the workings, dips south.

The output comprises—

20 tons for 73 oz., equal to 3 oz. 13 dwt. per ton
12 tons for 18 oz., equal to 1½ oz. per ton.

A lenticular leader north of the Mystery gave a crushing of—

6 tons, yielding 3 oz. total, equal to 10 dwt. per ton.

Callan's.—About four chains west-south-west of the main shaft on the old Sultan, three miles south of Clermont.

The reef strikes west 10° north, and dips northerly at 80°, while the country, reddish chloritic schist, dips about 60° to the south. It thus appears to be a fissure reef; but it is probably on a surface crack only, and not of any permanency. There are here probably several overlapping lenses, which, however, do not extend for more than 1½ chains, judging from surface indications.

The quartz varies from 6 in. to 2 ft. in thickness on the surface. It increases to an average of 18 in. in a trench 10 yards long and 6 ft. deep, and in the western end of the same cuts out. There are also thin veins of quartz in the country beside the main reef.

The quartz is white, but the cracks are iron-stained. On breaking either a pure white or a strongly-stained portion there is emitted a strong fetid odour (due to sulphuretted hydrogen).

Of the ore, 3 or 4 tons lie at the surface.

Bedford's (Whackford and Risien).—South of Macdonald's Flat, four and a half miles south-south-east of Clermont.

A new vertical shaft (3 ft. × 6 ft.) is being sunk, one chain to the west-south-west of the old underlie, and 50 ft. from the cap of the reef, to strike the reef at a depth of about 200 feet. The depth attained, early in August, 1904, was 95 ft (nearing the water-level). The country is slate, with lenticular quartz leaders every 3 ft. or 4 ft. dipping south.

The old shafts were full of water, but have been fully described by Mr. Dunstan, who mentions that a large amount of stone has been taken out and treated, and that on the 50 ft. level from 2 ft. to 6 ft. of the reef has been removed and crushed. "At the 70-ft. level the stone taken out was considered good, but the country is broken and the reef is not defined." Below the water-level no stone has been removed for crushing, but at the bottom the reef is from 5 ft. to 8 ft. thick.

The total crushings, up to September, 1900, were given as—

470 tons, yielding 498 oz. 7 dwt., valued at £1,611 13s. 2d.

with concentrates and cyaniding yielding gold worth £1,183 15s. 3d. Mr. Risien gave me the following additional returns:—

September, 1903: 27 tons 15 cwt. for 27 oz. 2 dwt., valued at £112 5s. 3d.
December, 1901: 100 tons (50 ft. "formation") 21 oz. 10 dwt., valued at £83 7s. 5d.

This "formation" was derived from crosscuts, totalling 51 ft. in length, on the bottom level.

Crown (abandoned).—A mile and a half east-north-east of Copperfield. The reef dips 70° to the south-south-east.

Two shafts have been opened since the mine was last visited. They are about 30 ft. deep, but inaccessible.

At the surface bright yellow micaceous schist, altering in depth to red and blue chloritic schist, is the country.

Palmtree (abandoned).—A quarter of a mile east of the Crown. In a hole a chain and a half east of the deep shaft can be seen about 12 in. to 15 in. of quartz on the hanging-wall, and 15 in. on the foot-wall, separated on the surface by an open fissure (central fissure probably), underlying 70° to the south. The stone looks very promising.

Mundic occurs in stone from the deep shaft, but the quartz there appears to be of the segregation variety. Magnesite seems also to have been met in sinking. A parallel leader has been opened south of the shaft.

Crushings have ranged in yield from 6 dwt. to 17 dwt. per ton. The schist country also dips south, but more steeply than the reef.

Lincoln Leaders.—Two and a half miles south-west of Clermont, on the western side of the Copperfield road.

Several shafts have lately been sunk, but the quartz is not very promising in appearance.

The leaders run east and west, and are vertical or dip to the south.

The schist country strikes north and south, and dips west, but it is much folded and veined with magnesite, derived presumably from a former covering of basalt (as indicated by the occurrence of "billy" boulders on the ridge top, 10 chains to the south).

The reddish soil in the vicinity has lately been receiving attention from dry-blowers.

Star of Hope.—Three-quarters of a mile north-east of the Copperfield copper lode. This has been fully described in Mr. Dunstan's report.

The crushings to 1902 amounted to—

1,030 tons, yielding an average of 15 dwt. per ton.

but a number of additional crushings have been made during the last three years. The last crushing, in February, 1904, was of—

60 tons for a yield of 2 dwt. per ton.

This, it is said, was from abandoned faces, which were known to be poor. Another crushing, in 1904, of—

22 tons gave 8 oz. 10 dwt., equal to 7 dwt. 17 gr. per ton.

(c) South-west of Copperfield.

Caldwell's.—At the Twelve-mile diggings on Big Ti-tree Gully, Brewery Creek, south-west of Copperfield, 12 miles by road, but only nine miles by track. This was not inspected by me, but Mr. Caldwell supplied the following notes:—

A trench, 12 ft. deep and 16 ft. long, has been cut in the hillside.

The leader is 4 in. to 12 in. thick, and runs east and west from slate into diorite, crossing a dyke of felsite.

The stone was poor in gold in the slate, but rich in the diorite, especially near a 9-in. fault, 1 ft. from the felsite dyke.

In August, 1904, the following crushing was reported—

9 tons gave 12 oz. 4 dwt., equal to 1 oz. 7 dwt. per ton,

but the Warden gives the total for 1904 as—

8½ tons crushed for 48 oz. 11 dwt., equal to 5 oz. 14 dwt. 5 gr. per ton.

Appendix III.

COAL-MINING.

A full report on the Blair Athol Coalfield* has already been published, and the following notes may be taken as supplementary to it, the work here referred to having been done since that report appeared.

Federal Colliery.

The Federal Lease is situated on what was originally part of the Carriers' Reserve, on the washpool, Blair Athol, 11½ miles north-west of Clermont.

The main shaft, 60 ft. deep, was sunk in 1898. The method of working is shown in the attached diagram. (Fig. 12.) From a main heading to the east, bords, 10 yards wide and 6 yards apart, run to the north; a second heading runs east and west, at 40 yards from the shaft, and from it stalls are being opened north and south. The coal requires to be blasted down.

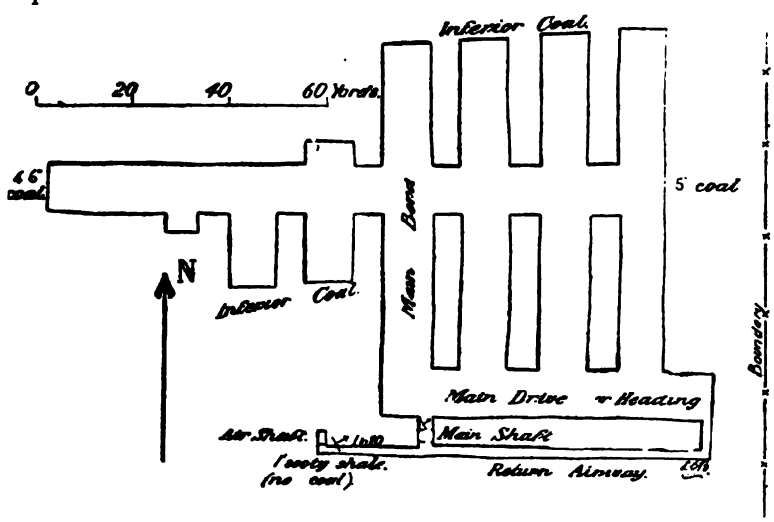

Fig. 12.—Sketch Plan, Federal Colliery, Blair Athol.

Scale: 40 yds. to an inch.

The seam averages nearly 5 ft. in thickness, but thin layers of shale appear occasionally 15 in. from the roof. In the present working face, north-west of the main shaft, there is 4 ft. 6 in. of coal, with a 6 in. coaly band above.

* "The Permo-Carboniferous Coal Measures of Clermont and Associated Formation." By B. Dunstan, F.G.S., Assistant Government Geologist, Brisbane. By Authority: 1900. G.S.Q., No 148.

Photo., L.C.B. FEDERAL COLLIERY, BLAIR ATHOL. **Plate 15.**

Though normal in appearance at the main shaft, the coal immediately west of it begins to deteriorate and thin out, and at the air shaft, 24 yards distant, there is only a foot of sooty shale, dipping 1 in 10 to the north-east. A borehole 400 or 500 yards to the west proved the seam to be altogether absent, but a lower one, 27 feet thick and of good quality, was cut at a depth of 80 feet.

A peculiar feature of the seam worked is the east-north-east striking zones of inferior coal, which, it has been noticed, correspond with rolls in the floor, rising about 18 in. above the general level. This deterioration may be due to incipient faulting in the roof, allowing volatile constituents to escape, the swelling of the floor having taken place as a result of the decreased pressure. This inferior coal is very friable, but "burns like sawdust" on an open fire. The zones are locally known as "faults," though no actual faulting can be seen.

A 12-in. band of turgite occurs directly over the coal in one place, and seems to be several yards in diameter. Another lenticular bed, 50 yards in diameter, was found in the Imbil.

The output for the previous three months had been 50 tons a week. The *personnel* consists of manager, two miners, and a whim boy. Six teams are kept going between the colliery and Clermont, the distance by road being 13 miles. The output for the year 1904 was 4,773 tons, valued at 15s. 10d. per ton; and the total to August, 1904, was 7,813 tons, valued at 16s. per ton. This was part of a contract with the Railway Department for 10,000 tons, which has since been completed.

Imbil Colliery.

Coal was last raised about three years ago, but a new shaft has just been sunk to coal. The hauling at both old and new shafts is done by whim.

In the old shaft the bottom of the top seam is at 60 ft. depth, but the new shaft, five chains distant to the north-west, is 90 ft. deep, and proved 4 ft. 6 in. of coal. A drive from the old shaft reaches within 20 yards of the new, and, in the face there, the coal is 6 ft. thick, though the average thickness in the old workings was 3 ft. 11 in. The little air shaft, near the old main shaft, was continued 9 ft. into the bottom seam.

The dip of the strata between the old and new shafts is 1 in 11 to the north 15° east.

Hope and Eldorado Collieries.

These collieries, both of which were provided with winding engines, have been idle, the Hope during the last six years and the Eldorado for the last two years.

Appendix IV.

NOTES ON ROCKS.

No work has yet been done on the specimens collected while in the district, owing to the pressure of routine work. It is, however, hoped that supplementary notes may be issued later, giving more information about the geology of the country inspected and the petrology of the rocks collected.

Billy.

Outcrops of billy were noticed at all the localities mentioned in the body of this report, specially large ones being found at the Springs, Black Ridge, McMaster's, Seventeen-mile Well, and Miclere, as well as less important ones at Yankee Camp and Black Johnson's.

At all these places the "billy" occurs either on the edge of the black soil plains or in the immediate vicinity of such.

Black Ridge.—The best-known outcrop is at Daintree's Knob. It has here in places a sintery appearance, especially when the boulders are coated with ironstone externally. The hard white billy quickly becomes brown exteriorly, on weathering. Much soft billy is found, as well as hard conchoidal; while beneath the solid "billy" is often a hollow space or else only partially cemented sand, known as billy sand.

"Billy" is understood to have been met, in sinking near Gowrie Creek, between the head of the creek and the Billiard-room. The belt extends northwards from Daintree's Knob beneath the surface, crossing the creek to the eastern side near the Bakery (where 20 ft. thick); and again crossing to the western side at Noonan's Store, after sweeping round the Old Cricket Ground, when it runs up the Old Puddler Gully to appear near Moxhan's Leap as a considerable "blow."

Seventeen-mile Well.—A billy blow, running south-east, was seen about 10 chains south of the crossing of the main Northern and Miclere-McMaster's roads.

Angular quartz billy forms a knoll, four chains in diameter and rising to 20 ft. above the surrounding plain, 30 chains north of the Seventeen-mile Well. There is chocolate soil on the north and black on all other sides of this outcrop.

Again, a little over a quarter of a mile to the south-east of the Well, a strip of billy, 15 chains in length and one chain wide, runs parallel to the Northern road, and adjoins the black soil downs.

McMaster's.—A large "blow" occurs about three miles west of the Ridge, rising 10 ft. above the adjacent black soil flat. Generally it consists chiefly of angular fragments of quartz, though at times the angular fragments are absent, and then a few rounded grains are to be seen. It has the appearance of a re-cemented residual schist deposit.

Billy outcrops occur north of the workings at McMaster's, and also east (towards the Ridge), there being large outcrops, probably 10 chains in diameter and up to 3 ft. thick, of both dense conchoidal and sandy cavernous rock on the edge of black soil. Quartz fragments in the billy are not properly rounded, and the sand is sharp.

Miclere.—Boulder Hill, a quarter of a mile south of Miclere Creek, and about half a mile west of its tributary, Coglan's Gully, is capped by one of the largest deposits of billy seen in the district. On the hilltop the billy cap is 2 ft. to 5 ft. thick, and 5 chains long by 2 chains wide. Gold has been worked between the billy and a soft clay bottom, and it is reported by Mr. Dunstan to occur in the billy itself.*

The billy, moreover, consists of angular quartz and schist fragments, ½ in. to 3 in. in diameter, cemented with a brownish-yellow siliceous paste. There is no doubt as to the angular nature of the quartz fragments; only one or two pebbles with edges even worn off were seen out of thousands, the quartz having exactly the appearance of that now shed by veinlets in schists. Angular fragments can be seen not alone in the billy, but also weathering out of it.

The billy here, as a whole, is much more impure than that seen elsewhere. It contains much schist, and the cementing material is almost always coloured grey or yellow, probably because originally clayey and ferruginous.

On the northern slope of the hill, the "billy" forms a cap, 3 ft. thick, resting directly on decomposed clay-slates, and, in section, has just the structure of residual soil, with bands of quartz fragments.

Billy caps the ridge south of the "tish" workings at the Lower Camp. It consists of the dense conchoidal variety, overlying billy sand—*i.e.*, sand only partly cemented by silica.

Billy is reported to occur on the left side of Miclere Creek, at the Twenty-two Mile, on the telegraph line, three miles below the Diggings.

Blair Athol.—About five chains north of the washpool crossing, on the Coal Mines road, and on the western edge of the black soil is an outcrop, 5 chains long and ½ chain to 2 chains wide. It consists of billy associated with magnesite.

"Clinker."

"Clinker" is of two kinds, both being products of the decomposition of basalt. The first, sometimes referred to as limestone, and most typically developed at Limestone Hill, near the All Nations Hotel, is magnesic calcium carbonate. It is generally found in irregularly shaped masses of a grey colour and porcellanous texture, though at Limestone Hill it forms a solid bed above the schists. It seems to have been deposited beneath the flow, from which it was derived, and its occurrence on a black soil plain is held by experienced miners to be

* G.S.Q., 176.

a certain sign of shallow sinking to schist or coal measures. The second kind is chalcedonic and dendriform, sometimes pink, but more often earthy-grey. It also occurs in black soil, but may not necessarily be a sign of the proximity of bedrock. It occurs in some quantity near the Northern road, north-west of Blair Athol Leasehold.

Granite.

With regard to the source of the granite boulders in the "wash," the nearest outcrop of muscovite-granite, such as that found in the "basalt lead" at Clermont, is reported to be at Douglas Creek, 20 miles to the south, but there may of course be unexposed dykes of the rock much nearer.

"Pilotstone."

Pilots are the heavy black boulders of quartz and tourmaline (?) rock, generally found where the gold is richest in the "wash."

Pilotstone, found *in situ*, was shown me by Mr. McDougall, from the junction of granite and slate, half a mile below Peak Vale Station.

Coal.

The occurrence of coal in the gold shafts in the vicinity of the Springs and Black Ridge has been recorded at Appleton's, on Linklater's Lead; at the coal shafts, on Spring's Creek; at an abandoned claim, on Daintree's Knob; at Mason's and Pengelly's claims, Black Ridge; and at an abandoned claim, Miclere. The seams are all small, and none of them were exposed when I was present.

Appendix V.

REFERENCES TO NUMBERS ON MAPS.

1. Beside the main northern road, near the creek, 1½ miles north-west of the Blair Athol leasehold. An outcrop of basalt, in large blocks.

2. Just east of Note 1. The soil is brownish, and contains a considerable amount of fragmental quartz, indicating that the schists are at no great depth.

3. The downs about ¼ mile north of the Old Cricket Ground. Occasional fragments of quartz are found in the black soil, showing that the schists continue north-westwards from the P.C.

4. Gowrie Creek, 5 chains north of the P.C. A pothole exposes 2 ft. 6 in. black soil over 2 ft. 6 in. brown soil on pink schist.

5. On Gowrie Creek, north-north-eastwards of the P.C. The surfacing at the creek consisted simply in removing 6 in. soil, but southwards the depth gradually increased.

6. Below the workings, but still on same side of Gowrie Creek. The soil contains quartz, but also much ironstone (limonite) gravel, and being brownish, was probably formerly covered by basalt, which it is probable extended southwards over Cumberland Lead and past Flyspeck, round Hard Hill to the open downs.

7. Gowrie Creek, half-way between Noonan's and the Puddlers. Top end of a deep breakaway in the banks of the creek, exposing 5 ft. dark soil above 2 ft. red clay, with angular quartz fragments, probably a residual schist.

8. Shaft on the northern bank of the creek, just below Note 7. In it 10 ft. black soil can be seen overlying a lighter material. The shaft bottomed in a brown micaceous schist.

9. The "Point" of the Black Ridge. In 10 to 14 ft. ground here it is reported 5 dwt. to the bag was obtained on washing.

10. South of Note 9, there was a poor patch, yielding only 4 or 5 dwt. per load.

11. The outcrop of the conglomerate on the eastern side of the Black Ridge, near Flyspeck. The best returns (30 dwt. to 4 oz. per load) were not obtained in surfacing, but in the shallow sinking in the conglomerate.

12. Half-way down Cumberland Lead. Residual clay, known locally as fireclay, with a strong saline taste, is exposed in the workings.

13. Hereabouts is a fall from 3 to 9 ft. depth. Two trails were followed a short distance, in the northern one the gold occuring at 8 ft. depth on "fireclay." In the other a few feet wide, the depth was less, but gold occurred from surface to bottom.

14. Stevensen's shaft. The sinking consisted of 40 ft. of "fireclay," resting on a decomposed clayslate bottom.

15. In the shafts south of Stevensen's 28 to 30 ft. of fireclay was proved.

16. Lewis' shaft. Sinking was in part in basalt.

17. Strong red soil (decomposed basalt (?)) with quartz pebbles.

18. Red shaft, 91 ft., south of the unworked ground. Fine gold, 10 to 12 dwt. to the load, ran in a trail down the slope to the west.

19. Meyer's: Shaft 104 ft. deep. Blue "wash," barren of gold. Bedrock chloritic slate.

20. Moxham's Leap "billy" outcrop. Occasional fragments of billy sandstone occur beyond the limit of the solid outcrop.

21. Continuation of the southern arm of the billy is probable, below the soil.

22. Billy occurs in patches under the flat north of the Old Cricket Ground.

23. Windlass well south-west of the Billiard Room. Reported that the wash carried only 2 dwt. to the load.

24. North of Daintree's Knob. Billy occurs beneath the flat in some of the shafts, 19 ft. in thickness, the upper 10 or 11 ft. being very dense and hard, the lower perhaps quite loose, and sometimes having a cavity beneath the harder cap.

25. Shaft south of McDonald's, Daintree's Knob. Gold occurred on a false bottom, the yields being from 1 to 5½ oz. to the load.

26. West of Daintree's Knob. Billy was met in sinking for a couple of chains west of the outcrop, though not seen on the surface.

27. Burn's, Daintree's Knob. Shaft 138 ft. deep; now used as a well; 6-in. wash and 3-in. bottom. Little gold.

28. 96-ft. shaft west of Davis' claim, Daintree's Knob. 4 oz. to the load. Pugh's, east of Daintree's Knob. Headings are being dry-blown.

29. Outside shaft (120 ft. deep), Daintree's Knob. In this shaft no gold was found, but no driving was done to prospect the ground.

30. In an abandoned claim, about 5 chains east of Davis', the wash is reported to have yielded 7 or 8 dwt. per load for a year. Coaly shale occurred near bottom.

32. Shaft near billy blow, on road south-west of Hard Hill. Sinking carbonaceous and pyritous shale over wash resting on a white siliceous slate.

33. Pothole proves fireclay over wash at 12 ft. depth.

34. Pothole proves 10 ft. decomposed basalt over quartz pebbles.

35. Shaft bottomed on schist shows 3 ft. surface pebbles over 10 ft. decomposed basalt.

36. South-east extremity of Hard Hill. Light soil, presumably schist, but shows much rounded quartz, perhaps residual from the conglomerates on the hill above. A few prospecting holes show clay with sintery lime formed from a former covering of basalt. In that case the basalt area should be shown extending almost up to Smith's workings, north-east of Hard Hill.

38. Possibly basalt beneath light surface soil.

39. Shaft on the south-eastern side of Pink Hill. Gold at 30 ft. on a false bottom, schist at 40 ft.

40. On top of Pewt's Hill there are no shafts owing to the hard bottom.

41. McFayden's claim was at the bend of the lead. His was practically the only payable ground.

42. Limestone Hill. Gold occurs in 6 to 12 in. surface soil with loose blocks of "clinker" on solid "clinker" floor.

43. 20 ft. shaft on Cement Hill. Wash occurred under "tish."

Shaft on Gowrie Creek above the Springs Hotel. Exposed 7 ft. black soil over 3 ft. of wash lying on a brown schist. Only the lower foot of the wash is payable auriferous.

44. Brown's adit, Cement Hill. Sandstone bottom dips 1 in 5 to the south.

45. Shaft sunk in grey conglomerate of schist and quartz pebbles.

46. South-east side Cement Hill. 10 ft. surfacing on schist bottom (reported).

47. Reported to be 10 ft. black soil and basalt, and 2 ft. "tish" on a schist bottom.

48. Springs Hotel Well. Sinking included 40 ft. basalt and "fireclay" and bottomed on "tish." A drive was then carried 30 ft. south to the base of the basalt, where a strong supply of water was obtained. It proves that the side of the old valley south of Cement Hill sloped steeply (1 ft. in 1½ ft.) to the southwards.

49. At Burnt School, on Springs Creek. The few rounded quartz pebbles are either drift or residual from a former capping of coal measures, for the schist outcrops in the creek.

50. Craven's. Sinking conglomerate, carbonaceous shale and "tish." Coal is reported to have been cut in this shaft just over the auriferous "wash" at 80 ft. depth. The bottom is a brown slaty schist.

51. 10 ft. shaft. Loose wash dipping 20° to north-east.

52. Shales from these shafts are rich in fossil leaves.

53. Quarry on Ti-tree Creek. Basalt exposed decomposing towards the surface into light kaolin.

II.—SUPPLEMENTARY NOTES

ON THE

BLACK RIDGE, CLERMONT.

By LIONEL C. BALL, B.E.,
ASSISTANT GOVERNMENT GEOLOGIST.

WITH 7 FIGURES AND 6 PLATES.

CONTENTS.

ILLUSTRATIONS.

FIGURES.

PLATES.

MAPS.

See Maps attached to first report, which have been brought up to date.

Supplementary Notes on the Black Ridge

(CLERMONT).

The following notes, made during a brief visit to the Black Ridge in September, 1905, may be taken as supplementary to the foregoing report.

I. GEOLOGY.

1. Faulting.

Further observation was made of faulting of both wash and bedrock. (*See* under descriptions of "Edward's and Ford's," "Last Chance," and "Rejected.")

2. Gold off Bedrock.

The occurrence was noted, in several parts of the Deep Ground, of richer wash many inches and even feet above bedrock, the wash on bottom being comparatively poor. (*See* "Pengelly's and Young's," "Pumpkins," &c.) This is important as showing the need for more careful prospecting of the "headings," the general practice hitherto having been to test only the lower foot of wash, which may in cases be almost barren, while that above may be rich.

3. Supra-basal Beds.

The existence in one or two claims of distinct layers of auriferous wash many feet above the basal beds is reported. ("Just-in-Time No. 2," and "Rejected.") In the same locality an extensive fault occurs, and it is possible that, the lowermost bed being unfavourable for precipitation, the gold was carried in solution to the upper beds. This would indicate the need for re-examination of the headings and upper layers of wash in those claims in which the basal wash has proved poor, especially where extensive faulting is known to have taken place (as in the "Endearer").

4. "Tish."

Deposits of tish beneath the wash have been found in some of the claims above the true bottom. (*See* "Just-in-Time," "Rejected," "Eclipse," &c.) As to its origin, I can offer no other explanation than that it consists of portions of the schist bedrock torn off and shattered by movement of the overlying coal measures.

5. Precipitation of Gold.

It must be acknowledged that there is more probability of precipitation of the gold from solution by carbonaceous matter than was evident at the time of my last visit. It will be found that carbonaceous shale occurs in the wash within a few feet of bottom in all the claims (with the possible exception of the "Just-in-Time") in which payable wash has been found, and that, as far as known, it is absent in the "duffer" ground.

6. Subterranean Contours.

Additional details were secured as to the contour of the "bottom"—*i.e.*, the surface separating "wash" (the basal bed of the coal measures) and bedrock (schists). A consideration of these shows that a subterranean valley or flat depression extends from Daintree's Knob north-north-westwards, and that a branch from the south-west enters it near the "Pumpkins" and "Bantam," on the Deep Ground. This depression appears to open out into a north-east and south-west valley at the "Contract," but the evidence of this is not yet conclusive.

If the "wash" lay in a lead, it would be necessary only to sink on the line of this depression to get the pay wash. It has, however, already been indicated that the deposits show none of the characteristics of a fossil river. The auriferous ground has been followed south-westwards from the Old Cricket Ground to the Deep Ground obliquely down the side of the depression, and in the Deep Ground the workings extend right across the bottom of the valley to the opposite slope. Similarly, the old Red Ground workings are on the northern slope of the depression, and may yet be proved to cross it.

7. "Runs."

It has been noted that working faces are not carried right through the claims, for the gold occurs in a number of distinct "runs," with, it is believed, a general east and west trend, though they are not always parallel, and in one case, in McGillivray's old claim, intersected. These "runs" of richer gold-bearing wash have no connection with the contour of the bottom beyond that they are seldom, if ever, found on very steep sidlings.

On the Old Cricket Ground the runs seemed, but not always, to have a south-westerly trend. In the Deep Ground they lie east and west and west-north-westerly. Thus, McGillivray is working two distinct runs, the northern having been traced between Mason's and the "Fraud" from the bakery on Gowrie Creek. It is believed that the "Eldorado" and "Just-in-Time," and probably the "Last Chance," are working a different run from that in the adjacent "Hope" and "Bantam"; "McLoskey's Mistake" and "Pumpkins" are on another;

and the "Just-in-Time No. 2," "Rejected," and "Eclipse" may be on still another. There is in consequence a possibility of runs being found between the "Pumpkins" and "Last Chance" and "Eclipse" and "Endearer"; but, further out, it can only be said that prospecting for east and west runs would have most chance of success.

8. Water.

The water at the Ridge, it may now be taken as proved, occurs in the basalt (generally the vesicular portions) in distinct reservoirs having little or no connection with one another. Station managers now also recognise that wells on the Downs yield sufficient supply for only a limited number of stock.

Practically all the trouble on the Deep Ground has been occasioned by the water occurring between a depth of 95 feet and the base of the basalt. It amounted in one shaft (the "Perseverance") to 2,000 gallons an hour. The water contains considerable salts in solution, but is rendered beautifully soft by boiling, whence it would appear that its hardness is due to carbonate of lime in a carbonic acid solution. A boiler, believed to be sound, soon, if using the water, shows signs of leakage on the joints—viz., incrustations and stalactites of white salts, in which the presence of sodium chloride may be detected by the taste. Boilers are, by the use of the water, rendered quite clean of scale, the deposit being loose and pulverulent.

II. MINING AND MILLING.

1. Prospecting.

Gold has been found in the basal conglomerates as far to the south-east as the Springs Hotel (3 miles distant); and in similar beds at the Venus (5 miles to the south-west), at McMaster's (4 miles to the west), and at the Miclere (9 miles to the north). The coal measures have been proved to continue north-westwards from the Black Ridge, but, except at "Chadwick's" (a mile to the north), the basal beds have nowhere been exposed and tried between the Ridge and Miclere. It is therefore evident that the beds should be prospected between the proved auriferous localities.

Very little more is to be expected of the miners, who, with little or no capital, have done a large amount of unproductive work. In addition to the extensive workings in the shallower ground, they have sunk, to the north of the richest line of claims on the Deep Ground, a dozen shafts, to depths of about 250 feet, in hard country, and at the same time they have had to contend with an inflow of water. The sinking of each of these shafts requires three months' labour of six men, and entails an outlay of from £10 to £16 per man for claim expenses. The Mines Department has assisted in the sinking of three of the shafts

(the "Endearer," "Last Chance," and "Neiht's"), to the extent of £1 per £1 of the cost of the sinking beyond a depth of 100 feet from the surface.

The only rational way of prospecting the ground is by drilling, of which, however, the whole cost would fall on the Government. Miners are prepared to sink shafts ahead if assisted financially; one party (at the "Bottletree") has, in fact, already without assistance sunk a shaft to water-level (at about 100 feet depth), 3 miles north of the Black Ridge.

The latest proposal is that of the Black Ridge Progress Association. It is for parties of miners to sink two shafts (quarter of a mile ahead of the claims on gold), assisted by a Government subsidy at the rate of £1 for £1 expended, the amount so received to be repaid out of profits, if any. If only two shafts were to be sunk, one of them should be located about a quarter of a mile north-west of Fraser's battery, the other a like distance north-west of the "Pumpkins," thus bringing the shafts within a quarter of a mile of one another. Alternatively to the latter, a shaft might be sunk about a quarter of a mile north of "Pengelly's and Young's." My reasons for chosing these sites are that the general run of the auriferous belt has been north-westwards from the Springs Hotel, and there appear to be alternate rich and poor areas crossing the belt, on east and west lines. If such is the case, the proposed shafts may be in auriferous ground, but in any case the locality would have to be tested sooner or later.

There were believed to be, in September last, some 300 men on the field, a considerable proportion of whom had their families with them, and for their future maintenance further developments must take place.

The output, September, 1905, of the Black Ridge (mostly from the Deep Ground) was 687 oz., valued at £2,750, the greater part of which, it is held, is spent locally and in the development of the claims.

2. Sinking.

To sink through the water-bearing rock it is necessary, when the water is heavy, and advisable in any case, to "pug" it back. The only method hitherto tried at the Ridge with success is the following:—The shaft is first carried through the water-bearing stratum, and is then enlarged in that stratum, to allow of heavy (8 in. diameter) timber frames being fitted in with 6 to 9 in. or more of clay packing behind them. (*See* Fig. 1.) The apparently more effective method of sinking the shaft only sufficiently to insert one frame at a time has failed, because of the difficulty of keeping the clay in place; but the use of a binding material, such as straw, hair, cocoanut fibre, or moss should obviate this difficulty. Auger holes are bored in the frames when in

place, and plugs of dried clay are driven in until the mass of clay behind has been driven into every crack, forming a firm and impervious wall.

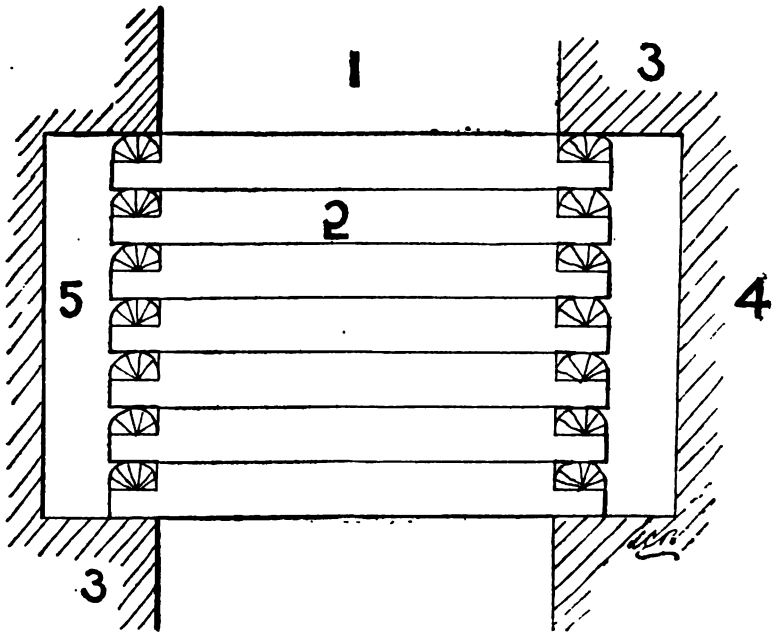

FIG. 1.—METHOD OF "PUGGING BACK" WATER.

Scale: 30 ft. to an inch

1. Shaft.
2. Round timber.
3. Impervious rock.
4. Pervious rock—water-bearing stratum.
5. Pug.

The water has had to be raised in buckets while this work was being carried out, and in several instances it has been found impossible to keep the water in the shaft low enough to allow the sinking to go on. The Government has, therefore, undertaken to supply a pump and boiler, at a rental of £1 per week. This will enable the pugging back to be carried out rapidly in each shaft, but it is not expected to have any great effect on the waterlogged condition of the ground in the adjoining claims. As mentioned, it is the water in the basalt that has occasioned the trouble in sinking, the comparatively small quantity yet met in the "cement" being quite under the control of the miners.

3. EXPLOITATION.

It is becoming the practice on the Deep Ground to work as much as possible in the bedrock because of its relative softness. To break down the wash a bench is carried beneath it, and, in prospecting, drives are often carried almost entirely in schist. This procedure has two defects: Firstly, considerable values must be lost in the packing,

especially in the richer ground, by what is practically overhand stoping; and, secondly, by driving in bedrock the wash is insufficiently prospected.

A face is carried along in the direction of the run of the richest gold, as found by panning off. In the majority of cases work is stopped as soon as the contents fall below what is considered payable, and operations are then transferred to some part where there are richer prospects. This greatly increases the cost of mining, and it has been proved to be better to continue, even though the wash for some feet may be unpayable, the average return still giving a profit.

It has been estimated that in ordinary working six men raise an average of from 12 to 15 tons (24 tons being quite exceptional) of wash a week, which is equivalent to only 2½ tons per week per man. This, it is generally acknowledged, could be greatly improved upon were the miners seized of the necessity.

Those of the claims which have connected with adjacent workings have good natural ventilation. In the others ventilation is assisted by "centring" (*i.e.*, partitioning) the shaft and carrying out two drives or one double drive; and most of them are in addition provided with hand-blowers. At the "Pumpkins" a windsail is also attached to the ventilating pipe. (Plate 1.)

4. Millwork.

The Black Ridge battery, fifteen head of stamps, is capable of putting through 40 tons of "cement" per twenty-four hours. "The slimy sands carry 1 dwt. per ton, and the pure slimes 1 dwt. 7 gr. per ton, while the pure sands are quite free of gold." (Plate 2.)

Mr. Donald Fraser, manager of the battery, has supplied me with the following returns:—

> Middle May, 1905, till 13th Sept., 1905: 2,387 tons cement crushed for "an average yield of nearly an ounce."

Of this quantity—

> 285 tons was put through as a trial, and gave only 1 dwt. per ton, including 65 tons trial from the old Black Ridge puddler tailings.

(*a*) *Amalgamation.*—Mr. Fraser informed me that the gold in the oxidised "cement" will not amalgamate except after trituration (*i.e.*, prolonged battery treatment), probably owing to a coating of iron oxides. Further, that when coaly bands are present in the wash, the mercury is "sickened" during retorting. This may be due to the presence of sulphur in the coal.

5. Costs.

The following items of local costs may prove of interest to some:—

(*a*) *Whim and Poppet-legs.*—

Round timbers (eight legs, tie-beams and crosspieces) delivered at the mine	£3	5
Sawn timber (for whim frame)...	2	5
Contract price for erection	13	0
	£18	10

This is one special case; on other claims the total cost has been from £20 to £30.

Photo., L.C.B. **Plate 1.**

VENTILATING APPLIANCES, "PUMPKINS," BLACK RIDGE.

"BUFFALO" HAND-BLOWER, WITH ATTACHED WINDSAIL.

Photo., L.C.B. BATTERY, BLACK RIDGE. **Plate 2.**

(*b*) *Mining and Hauling.*—The total cost of labour (calculating at the local rates) of raising and paddocking a ton of crushing stuff, in the most favourable instances, does not fall far short of £1 per ton, and in the others is far greater. The cost in 200 to 250 feet ground of raising and crushing, in addition to the actual labour of the six (four to ten) claimholders, is 16s. to 17s. per ton.

(*c*) *Crushing.*—The following are the charges for crushing (including carting from the claim) at the Black Ridge battery:—

"Cement" (carrying ½ oz. or over)	12s. 6d. per ton
"Cement" (carrying under ½ oz.)	10s. per ton

For crushing only (as at Copperfield) the rate is:—

Quartz (up to 25 tons)	16s. per ton

6. Output.

The 1905 returns, given below, have been taken from the Warden's monthly reports in the "Queensland Government Mining Journal," but the Warden since reports these to be only partial returns:—

Jan.	446½ tons, yielding	478 oz.		
Feb.	Puddlers, ,, ...	147½ oz.	625½ oz.	
Mar.				
Apr.	311 tons, ,,	147 oz.		
May	? ,, ,,	997 oz.	... ...	1,144 oz.
June				
July	365½* ,, ,,	190 oz. 6 dwt.	190 oz.	
Aug.	755½ ,, ,,	687 oz. 14 dwt.	688 oz.	878 oz.
Sept.				

The value of the gold is given as £4 per ounce.

III. BLACK RIDGE CLAIMS.

Descriptions of the claims on the Deep Ground and one or two other localities are given below.

My time would not permit me, and it was not considered necessary, to revisit the old claims on the Old Cricket Ground and Daintree's Knob and the new ones on the Blue Ground.

1. Deep Ground.

The "Nipper," "True Blue," "Eldorado," "Bantam," "Pumpkins," "Pengelly's and Young's," and "Last Chance" had been pegged out at the time of my last visit a year ago. New claims west and north of them are:—The "Eclipse," "Endearer," "Rip and Tare," "Ruby," "Neiht's," "Perseverance," "Family Circle," "Southern Cross," "Dolphin," and "Contract." New claims to the south are:—"Just-in-Time," "Hope," McLoskey's Mistake," "Rejected," "Neiht's New," "Brilliant," "Just-in-Time No. 2," "Just a Chance," "Homeward Bound," "Jackson's," "Excelsior," "Waratah," "Moonshine," "Dido," "Star of the South," "Try Again," "Eureka," "Allan's," and "Hopeful."

* Among the July crushings was one of 200 tons of mullock for 12 oz. 10 dwt.

The extreme northern shafts (the "Family Circle," "Dolphin," "Southern Cross," and "Contract") succeeded in bottoming, but not on payable wash. Comparatively little prospecting was done owing to want of funds, but it is quite possible that runs of payable wash may lie between the shafts, the prospecting having been altogether insufficient to prove the contrary. "Pengelly's and Young's" is the only claim on the north from which crushing stuff has been sent to the battery.

The north-western shafts (the "Ruby," "Neiht's," "Perseverance," "Rip and Tear," and "Last Chance") struck such heavy water that the sinking had to be stopped before bedrock was reached.

While there is nothing to show positively that payable wash will be found in this part of the field, there is every justification for the sinking of these shafts. The "Southern Cross" workings, the furthest to the north-west, should be extended, as the proving of payable gold here would open up a large extent of untried ground.

On the west the "Eclipse" is raising payable wash.

South-westwards "Neiht's New," "Just a Chance," "Star of the South," "Homeward Bound," and "Try Again" are still sinking. It is not known for what special reason these claims were located here, except perhaps because good gold is being got in the "Eclipse," south of the shaft. Runs may, of course, be found, but the probability is against any considerable belt of auriferous ground lying in this direction, for the schists outcrop within a quarter of a mile, and no surface gold has been found on them.

On the south the "Just-in-Time," "Hope," and "McLoskey's Mistake" are in rich ground; and the "Brilliant," "Just-in-Time No. 2," "Rejected," and "Dido" are working; but the other claims south and south-east have been abandoned. The ground south of the old rich claims and their "side liners" appears to be a poor belt, the continuation of which was found to the east in the Blue Ground.

The claims are taken below in alphabetical order, and particulars are given as far as possible with reference to—

i. Extent of claim and location of main shaft.
ii. Area of workings, methods of working, &c.
iii. Influx of water.
iv. Character of wash and bottom.
v. Nature of bedrock.
vi. Condition of crushing material.
vii. Output.

Where they have a registered title, the claims have been described under it, even though some other name, often that of a shareholder,

Photo., L.C.B. **DEEP GROUND, BLACK RIDGE.** **Plate 3.**

(LOOKING WESTERLY FROM THE "TRUE BLUE.")

may be in more common use, the latter being then given in parentheses. Much unnecessary inconvenience is caused people on and off the field by the careless method hitherto used in referring to workings and recording of outputs.

"*Allan's*" (Grace's, &c)—

i. The claim was abandoned in April, 1905. Position: 13 chains south of the "Nipper."

ii. The shaft is 184 feet deep.

iv. There is reported to be coaly shale in the shaft about 4 or 5 feet above bottom.

vii. No particulars could be obtained as to output, but the headings on the tip contained sufficient gold to make it worth while dry-blowing them (September, 1905).

"*Bantam*" (Heuat's, Christensen's, Caldwell's)—

i. Area: Six men's ground. Position: 4 chains west by north of the "Eldorado."

ii. The shaft (5 feet by 2 feet) is 234 feet to bedrock, and bottomed in August, 1904. A stope was opened for 30 feet west of the shaft and 40 feet south. A drive (130 feet to the boundary) connects with "McLoskey's Mistake" shaft, and from it a stope, 45 feet wide, has been carried about 60 feet eastwards, in proximity to the boundary. The present face is on the western side of this drive. Future work will be on the north-eastern side of the shaft.

The following items of costs per ton of ore have been supplied to the Warden:—Explosives, 5s. 4d.; horse feed, 2s. 1d.; wear and tear material, 1s. 6d.; candles, 2s. The total cost, with crushing at 12s. 6d. and mintage, &c., at 2s., is thus, exclusive of labour, 25s. 5d. per ton.

iii. No water.

iv. Conglomerate (with "smooth floors," 5 or 10 feet apart, and not all dipping in the same direction) was entered in the shaft at a depth of 107 feet. "Colours" of gold occurred in the conglomerate just above these floors, and also at a depth of 225 feet. A coal seam, ½-inch thick, was cut in sinking, and coaly shale, said to be sometimes auriferous, also occurs in the wash. The wash is reported to carry a little mineral (pyrite), though I saw none.

In the southern stope is an area of schist tish, 20 feet across and 2 feet thick, and colours of gold are reported beneath it on bottom. In the same place the section shown in Fig. 2 is to be seen, pay wash occurring both above and below a bed of very fine, almost barren, wash. The richest gold (amounting to 4 dwt. to the dish) is between

thin patches of coaly shale and the bottom. The whole 6 feet average $9\frac{3}{4}$ dwt. per ton.

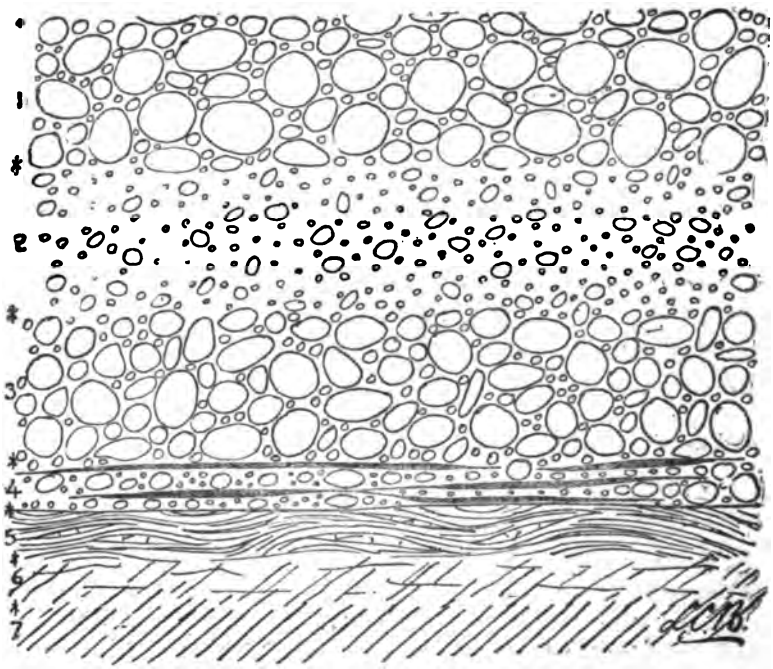

FIG. 2.—SECTION OF WASH, LOOKING NORTH NEAR "ELDORADO" BOUNDARY, "BANTAM."

Scale: 2 ft. to an inch.

1. *Coarse wash,* 10 *to* 12 *dwt. gold per ton.*
2. *Very fine sandy wash, containing "colours" only.*
3. *Coarse wash,* ½ *oz. per ton.*
4. *Wash, with* ½*-in. layers of black shale,* 4 *dwt. to the dish.*
5. *Leader schist with quartz lenses.*
6. *Broken schist.*
7. *Solid schist.*

The general slope of bottom is somewhat interfered with in this claim by a west-north-west channel crossing between the shaft and "McLoskey's Mistake." The slope, on the whole, however, is northwards or noth-north-eastwards, usually at 1 in 10, though there are still deeper slopes (one in the eastern face being 1 in 5 to the north-east). The bottom throughout the claim is polished, and there are signs of projections of bedrock having been shorn off during the movements producing the slickensides.

v. Bedrock is massive schist, which in some parts has, for a foot beneath wash, been veined with flat lenticular leaders of quartz. The faces of the joints are then often coated with a white kaolin.

When the schists are on edge, colours of gold are found in them as much as a foot beneath bottom. In places the upper portions of the laminæ appear to have been bent over (from south to north) by the pressure of the superincumbent moving mass. On the extreme southern face the bedrock is much contorted and jumbled, and the wash is poorer.

Photo., L.C.B. **DEEP GROUND, BLACK RIDGE.** **Plate 4.**

(LOOKING EASTERLY FROM NORTH-WEST OF THE "RIP AND TEAR.")

vi. Up to 6 feet of wash (with auriferous bands) has been broken down.

In the stope west of the shaft only 12 inches of wash (most of the gold being in the 6-inch beneath a coaly shale) and 6-inch bedrock was taken. In one place 1 inch of "puggy wash" beneath the cement carries ¼-dwt. to ½-dwt. to the dish. In the extreme south of the southern stope from 12 to 18 inches is payable, and on the northern side of the stope 3 to 6 feet, though in the centre of the stope the wash was only 12 inches thick. In the present face near "McLoskey's Mistake" 12-inch wash and 4 to 6 inch bedrock is removed for treatment.

vii. Output*: From the stope at the shaft—

Total 1904: 135 tons for 188 oz. =1 oz. 8 dwt. per ton.

From the drive—

May, 1905: 62 tons for 65 oz. 15 dwt. =1 oz. 1 dwt. per ton.
July, 1905: 200 tons (mullock) 12 oz. 10 dwt.

From the southern stope—

July, 1905: 185 tons for 204 oz. 14 dwt. =1 oz. 2 dwt. per ton.
Aug., 1905: 118 tons for 82 oz. 15 dwt. =14 dwt. per ton.
Sept., 1905: 52 tons for 25 oz. 12 dwt. 12 gr. = 10 dwt, per ton.

The last crushing included 6-feet ground.

The claim has paid shareholders from £6 to £9 per man per week since bottoming. The last crushing, which took three weeks to raise, gave £6 a week, and the August crushing gave £7 per week per man for six weeks' work.

Battery Well—

i. Position: 14 chains north-west by west of "Pumpkins."

ii. This shaft is now (September, 1905) 119 feet deep.

iii. The amount of water raised is 500 gallons an hour.

iv. It was sunk in solid basalt to 100 feet; then in vesicular water-bearing basalt to 119 feet. The basalt is somewhat decomposed, and veined with green halloysite (hydrous silicate of alumina).

"Bedford's" Old—

i. Two or three parties, including Mason, have lately cleaned the shaft out, but no crushing has been raised. That given by the Warden as Hickey's or Mason's came from Carroll's claim or Daintree's Knob.

ii. The shaft, 209 feet deep, is still inaccessible. The western drive has been carried forward 60 feet, and the southern 40 feet.

iv. It is understood that gold was found wherever there was any "wash."

The slope of bottom is 1 in 4 to the north-west.

"Bergman's"—

i. Position: 10 chains west-south-west of Grant's hut on Daintree's Knob.

* The Warden's return for 1905 is 575¼ tons for 526 oz.

ii. The shaft is 101 feet deep. It is now caved in.

iv. Colours are reported to have been found from 100 to 101 feet. Beneath the wash is barren tish.

"*Bottle-tree*" (Dequine's and Dixon's)—

i. The Bottle-tree prospecting area includes two men's ground (200 by 200 feet), and is temporarily abandoned. Position: It lies about a mile north-east of the Seventeen-mile Well, and 2½ miles north-west of the Black Ridge battery.

ii. The shaft is 116 feet deep.

iii. At 110 feet depth a flow of water (50 gallons a day) was struck and proved too heavy for the two men to overcome.

iv. The sinking consisted of "billy" and clinker at surface; then soft white sand and clay to 60 feet; and then conglomerate and sandstone. The conglomerate is typical oxidised Black Ridge cement, white in the upper part, but reddish in the lower. Traces of gold were occasionally found in the sinking.

Two shafts on the creek about 15 chains to the north-north-east appear to have met a tish or schist bottom dipping westwards within 30 feet of the surface. The hill rising above them on the north is probably tish; it is not conglomerate.

The "Bottle-tree" has an important bearing on the future of the Ridge, in that it proves the continuation of the coal measures northwards.

"*Brilliant*" (originally Greave's and Meare's, now Wilson's)—

i. Area: Six men's ground. Position: 5 chains south-south-east of the "Nipper."

ii. The shaft is 214 feet deep (to bedrock). From the shaft the ground has been worked out for 1½ chains to the south, and round for ½-chain to the west, the reason for not continuing the stopes in this direction being the proximity to the boundary. A prospecting drive to the north-north-east is now (September, 1905) 100 feet in length.

iv. The wash is neutral tinted. The bottom slopes very slightly westwards, without any sign of pug, beneath the gold or elsewhere.

v. Bedrock is flat-bedded, massive, slaty schist, which, in the face of the northern drive, is becoming softer, and therefore more promising for the occurrence of gold. It is here fissured to some extent, and east and west cracks pass from it into the wash, with a noticeable effect on its productiveness.

vi. About 9 inches of bedrock and wash is crushed, the gold being chiefly on cracks in the schist. The contents vary greatly, 4 gr. to the dish (1 oz. to the ton) being sometimes found after a week's run on little or nothing; in fact, "the prospects are patchy." In the old workings 7 dwt. to the dish once resulted. It is considered that

12½ dwt. per ton would pay well if uniformly distributed, but that amount does not pay while it is necessary to be continually running out prospecting drives.

vii. The output from the ground south-west of the shaft comprises—

Feb., 1905: 24 tons for 9 oz. 10 dwt.	=	8 dwt. per ton.
April, 1905: 41 tons	=	7½ dwt. per ton.
May, 1905: 25 tons for 20 oz.	=	16 dwt. per ton.
July, 1905: 58 tons for 21 oz.	=	7¼ dwt. per ton.
Aug., 1905: 55 tons for 34 oz.	=	12½ dwt. per ton.

"*Contract*" (Borl's originally, and later Linton's)—

i. Area: Nine men's ground. Abandoned by Borl in May, 1905. Position: 13 chains north of "Pumpkins."

ii. This, the biggest local shaft (6 feet 1 inch by 2 feet 6 inches), is 259 feet deep (to schist), and is still accessible. Drives extend for 13 feet to the south-west, and for 16 feet to the east.

iii. There is a slight seepage from the cement in the north-eastern corner of the shaft, probably noticeable only in damp weather.

iv. It is reported that no coal was cut in sinking. The cement may be rather more indurated than is favourable, but the drives being in bedrock, only the lower 3 inches to 12 inches has been exposed. It is here rather more pebbly than in the "Family Circle," and in places is somewhat sandy. Shotty colours were reported to have been found in July, 1905.

In the face of the south-western drive is a jump-up (not a fault) of at least 12 inches to the south-west; the slope of the bottom is elsewhere very slight—viz., west of the shaft 1 in 40 to the north-west, and east of the shaft 1 in 30 to the south-west.

v. Bedrock is foliated neutral tinted or blue and white schist, the foliæ of which dip only very slightly (to the south-west). For from 6 inches to 12 inches below the cement the bedrock has been crushed, or is rather more openly laminated than below. In this part, especially, white, clayey seams have been developed on the laminæ. There seems to be sometimes ¼-inch pug, 3 inches below bottom.

"*Dido*" (Dequine's and Collin's, originally O'Hara's "Blackbutt")—

i. Area: Six men's ground. Position: 7 chains south of the "Bantam."

ii. The shaft is 199 feet deep. Old drives run 30 feet north and 5 feet south of the shaft, and a little ground was stoped out near the shaft. A drive is now being carried up the slope to the west-south-west. The workings were not inspected by me.

iv. The thickness of basalt pierced in the shaft is 30 feet. The strata beneath the basalt dip to the east in the shaft, but to the west in the western drive. No colours have yet been found.

There is a sudden rise (fault?) forming a "bar" a few feet west of the shaft, the bottom being now nearly level. The drive from the shaft was carried through the "bar," and is now half in wash and half in bedrock.

vii. Neither the original nor the present party has had a crushing.

"*Dolphin*" (Finger's, "Cockey's," or "Douglas Creek party")—

i. Area: Nine men's ground. Exempt. Position: 10 chains north of "Pumpkins."

ii. The shaft reached 256 feet from the surface. There are short drives 12 feet in length to the south-west, and 12 feet in length to the east. Inaccessible.

iii. The water amounted to only 15 or 20 gallons an hour.

iv. White billy sand seems to have been struck beneath the basalt.

The wash contains still more quartz than that in the "Contract." Colours of gold were found on opening out from the shaft.

The slope of bottom was towards "Pengelly's and Young's."

"*Eclipse*" (Madge's and Croft's)—

i. Area: Six men's ground. Position: 3½ chains west of "Pumpkins."

ii. The shaft (5 by 2) is 204 feet deep (expected 270 feet.) From it a face was carried out for 25 feet across the dip to the east-south-east. The present face, 30 feet in width, is being carried to the south-south-west to the rise, and is now 60 feet from the shaft. A drive on the north-north-east of the shaft is 10 feet in length. On account of the steep slope of bottom in this drive, the shaft is to be continued from 11 to 15 feet below the wash, and a drive will then be put out to the north to catch the wash on the dip.

iii. Water has been struck both in sinking and in opening out in the cement, the total amounting to 300 gallons a day, of which only 20 gallons comes from the cement.

iv. The reddish oxidised, but barren, cement changed to blue at about 180 feet depth, and colours of gold were found in this as much as 15 feet above bedrock.

The wash has much the appearance of tish, and, like the bedrock, has a strong reddish tint, while it contains abundant quartz pebbles, which are not well-rounded, though they generally have their edges worn off. The larger boulders are always fairly well rounded. That it is of sedimentary origin is proved by the occurrence of layers of shale in it, both in the southern stope (where fossiliferous), in the eastern

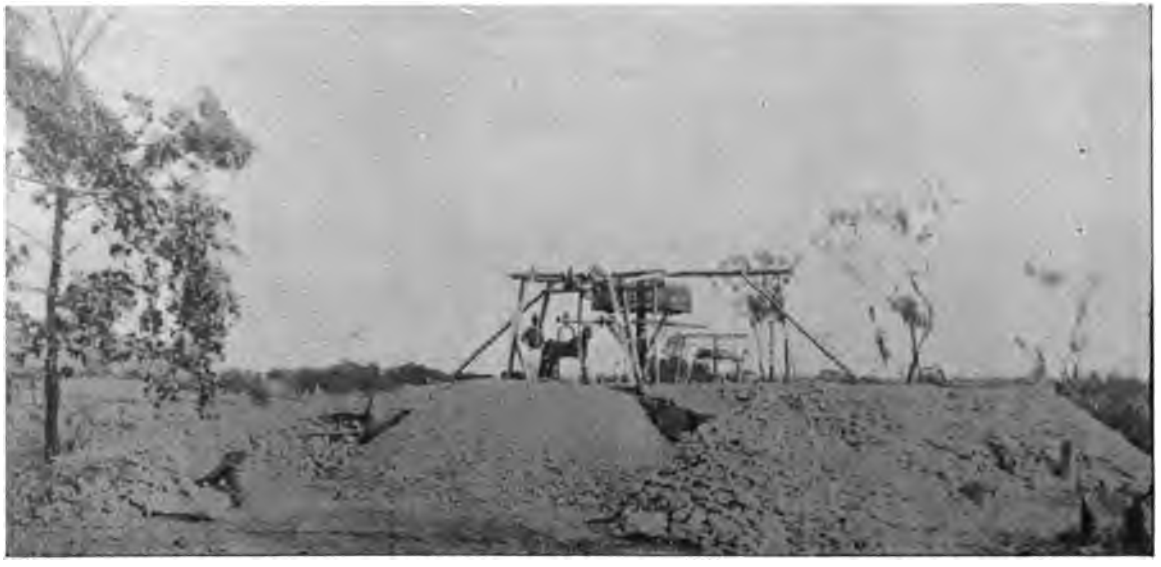

Photo., L.C.B. THE "ELDORADO," BLACK RIDGE. **Plate 5.**

(SHOWING PADDOCK OF CRUSHING STUFF AND HEAPS OF REJECTED BOULDERS.)

face where it rests on bottom, and in the northern drives where it is 2 feet from bottom and accompanied by a large quantity of quartz pebbles.

Gold occurs both above and below the shale patches, and it is found to be richer when the wash is fairly coarse, with abundant quartz boulders. It is also, contrary to the usual expectation, better here when the bedrock hardens. A "pug" in the bottom of a pot-hole was reported to have swelled upon exposure. In one place shotty gold was found, one speck weighing 7 dwt. Most of it is, however, less than ⅛-inch in diameter, flaky, and sometimes crumpled. "Specimen" gold is also found, the gold having been perhaps precipitated on angular quartz fragments.

The slope of bottom varies between north-north-west and north-north-east, and south of the shaft is only 1 in 20; but just to the north of the shaft it abruptly falls off to 1 in 4; within a few feet is 1 in 1, and in the face of the drive is 1 in ½ to north 2° east. This steep dip indicates the existence of a deep channel between the "Eclipse" and "Endearer."

v. The bedrock is soft, foliated schist, the laminæ of which dip about 30° to the south-west.

vi. Between 6 inches and 3 feet 6 inches of wash (an average of 2 feet) is broken down for treatment; in the eastern face 2 feet 3 inches wash and 2 inches bedrock carry 8 dwt. per ton.

vii. The output* consists of:—

April, 1905: 62 tons yielded 33 oz. = 10 dwt. 15 gr. per ton.
July, 1905: 57½ tons yielded 23 oz. = 8 dwt. per ton.
Aug., 1905: 80 tons yielded 58 oz. 8 dwt. = 14 dwt. per ton (a month's work).
Oct., 1905: 78 tons = 7 dwt. per ton.

"*Eldorado*" (Hennessey's and Keane's)—

i. Area: Six men's ground. Position: 3½ chains west of "True Blue."

ii. The shaft is 240 feet deep. A face 45 to 50 feet wide has been carried 55 feet northwards from the shaft along the "True Blue" boundary and southwards 100 feet to the "Hope." The present face south-west of the shaft has been carried 70 feet along the "Hope" and "McLoskey's Mistake" boundaries. The workings are connected with the "True Blue."

iii. In sinking red cement was met at 88 feet from the surface, the change to blue taking place at 150 feet, where there is a 3-inch seam of coal, which was used in the forge for sharpening picks. Another 1-inch seam of coaly shale was found at a depth of 230 feet.

The wash contains much granite, especially north of the shaft, where it is also very coarse. The best gold has been found where there is "dig" on bottom, the ground west of the shaft, where it is absent,

* Warden's return for 1905: 484 tons for 194 oz. 6 dwt. 13 gr.

being poor. The wash, north of the shaft, has averaged 24 dwt. per ton, and much of that south of the shaft ran 1 oz. The richest ground was in the vicinity of the shaft.

In one place about 30 feet south-west of the shaft 2 feet of tish occurs in a depression in the bottom. Though 3 gr. to the dish has been obtained from the wash above it, the tish does not carry a trace of gold. The slope of bottom south of the shaft varies from almost level to 1 in 10 to the north-west, and north of the shaft it is 1 in 30 to the west. A channel ran south-eastwards past the shaft on the south.

v. The bedrock is slaty schist dipping flatly westwards.

vi. Over a considerable area south, and to some extent north, of the shaft 2 feet 6 inches wash was broken down for treatment. From 2 feet 6 inches to 3 feet wash is exposed now in the northern face, but west of the shaft it is thin and poor, while south-westwards from 9 inches to a foot is taken. In the present face on "McLoskey's Mistake" boundary 6-inch wash and 3-inch bedrock is taken.

vii. The following is the output*:—

Total for 1904: $316\frac{1}{20}$ tons for 591 oz.	= 1 oz. 12 dwt. per ton
Feb., 1905: 75 tons	= 23 dwt. per ton.
30 tons (mullock)	= 8 dwt. per ton.
125 (?) tons (mullock) for 27 oz.	
June, 1905: 217 tons for 195 oz.	= 18 dwt. per ton.
Aug., 1905: 77 tons (including 20 tons of ½-oz. "headings") for 149 oz. 14 dwt.	= 1 oz. 19 dwt. per ton.
Sept., 1905: 75 tons for 112 oz.	= 1 oz. 10 dwt. per ton.

The mullock consisted of packing in the stopes, and included as much as 3 feet of bedrock, from where the 5-oz. crushings were obtained on the southern side of the shaft.

"*Endearer*" ("Endeavour," Tasker's, or "Spaniard's")—

i. Area: Six men's ground. Now exempt. Position: 4 chains north-west of the "Pumpkins."

ii. The shaft is 197 feet to bedrock, and now is accessible. A drive was opened on the underlie for 12 feet. The shaft was then continued into bedrock to a total depth of 212 feet, and a drive was carried out to the wash and along bottom for 62 feet to the north-north-east (falling 25 feet). This was because of the bottom forming an overhanging ledge, as shown in Fig. 3. A drive was also opened for 12 feet on the rise to the south-west. It is the shareholders' intention, on resuming work, to drive 60 feet to the south.

iii. The bottom of the main water zone is 135 feet below the surface; but water also came from leaders in bedrock.

* Warden's return for 1905: 550 tons for 668 oz. 7 dwt.

iv. The wash is favourable in appearance, but contains no gold. The bottom is reported to slope 1 in 1½ towards the north-north-east.

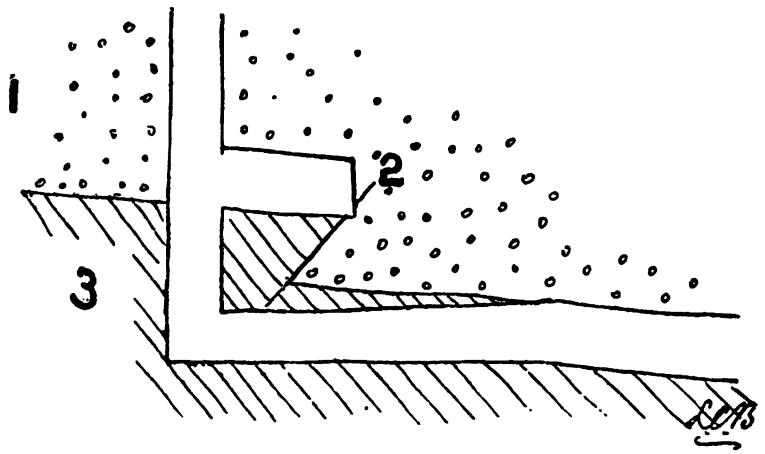

FIG. 3.—FAULT IN "ENDEARER."

Scale: 20 ft to an inch.

1. Wash. | *3. Schist.*
2. Fault.

"*Eureka*" (Kelly's, Pugh's, or Agnew's)—

i. Abandoned early in September, 1905. Position: 9½ chains south-south-east of "Eldorado."

ii. The shaft is 200 feet deep, with drives 50 feet, 58 feet (east), 16 feet (south), and 35 feet (west). Inaccessible.

iv. The wash was very thin, and the run was only 10 feet in width.

vii. The output comprises:—

19½ tons	for 10 dwt. per ton
45 tons	for ½ oz. per ton
(including 22 tons, yielding 11 oz. 8 dwt. = 10 dwt. per ton.)	

The headings are now (September, 1905) being dry-blown.

"*Excelsior*" (Lyall's)—

i. Area: Six men's ground. Abandoned. Position: 8½ chains south-south-east of the "True Blue."

ii. The shaft is 203 feet to schist, and was continued 6 feet, when a drive was opened. Inaccessible.

iv. A large body of low-grade wash was reported to occur here. The slope of bottom is 1½ in 1 to the east.

vii. Output:—

June, 1905: 18 tons for 3 dwt. per ton.

"*Family Circle*" (Ambrose's)—

i. Area: Nine men's ground. Exempt. Position: 10 chains north-west of the "Nipper."

ii. The shaft is 245 feet deep; the eastern drive is 80 feet long; the western 15 feet. These workings are now flooded by water from the cement, and are inaccessible.

iii. There is reported to have been an open water-bearing vugg in the cement in the shaft, and 2,500 gallons a day was raised while sinking. It is understood that no coaly shale was found in the shaft. The neutral tinted cement on the tip is made up in great part of micaceous schist, but contains also much spotted schist and most of the boulders are less than a foot in diameter.

This was reported a "duffer," but it is rumoured that fair prospects (½-oz. per ton) were found at from 20 to 35 feet in the eastern drive, and I saw colours myself in the stone on the brace. No gold occurred on bottom, but as much as 2 gr. to the dish 2 feet above (*Peak Downs Telegram*, December, 1905).

The slope of bottom is, according to some, towards the "Contract," according to others towards the north.

"*Homeward Bound*" (Lewis's)—

i. Position: 10 chains west-south-west of "Pumpkins."

iv. At 60 feet depth, just passing from brown decomposed into solid blue basalt, needing to be blasted.

"*Hope*" (Moylan's, McMillan's, Potts's, Taylor's)—

i. Area: Six men's ground. Position: 2½ chains south-south-west of "Eldorado").

ii. The shaft is 230 feet deep. From it the ground has been stoped northwards 20 feet (to the "Eldorado") eastwards 37 feet, westwards 20 feet, and south-westwards 20 feet.

iii. The workings are now quite dry.

iv. The change to blue ground was reported at 200 feet depth.

The wash is similar to that on the adjoining claims. Pug occurs on bottom north-west of the shaft and good gold is found there.

The slope of bottom is 1 in 30 north-westwards.

v. Bedrock is laminated blue slaty schist; and the laminæ dip 45° to the west.

vi. The crushing material comprises 12 inches of wash and 6 or 8 inches of bedrock.

vii. The output* is:—

May, 1905: 57 tons yielding 22 dwt. per ton (largest piece 16 dwt)
Aug., 1905: 75 tons yielding 81 oz. = 21 dwt. per ton.
Sept., 1905: 45 tons.

"*Hopeful*" (Donaldson's)—

i. Area: Six men's ground. Abandoned. Position: 12 chains south of "Eldorado."

* Warden's return for 1905: 247 tons.

ii. The shaft is 158 feet deep. It was considered that the shaft bottomed too shallow, and, as no gold was found at the shaft, no further work was done.

"*Jackson's*"—

i. Area: Six men's ground. Abandoned, June, 1905. Position: 10½ chains south of Mason's.

ii. The shaft is 205 feet deep.

iv. The bottom slopes west.

vii. One small crushing was made and the ground was then abandoned:—

May, 1905: 16 tons for 4 oz. 6 dwt. = 5 dwt. per ton.

"*Just-a-Chance*" (Lloyd's)—

i. Position: 5 chains south-south-west of "Pumpkins."

ii. The shaft is in process of sinking.

iv. The base of the basalt sloping 1 in 1½ was met at a depth of 87 feet. None of the basalt is vesicular here, and no water was found in it.

"*Just-in-Time*" (McDonnell's)—

i. Area: Six men's ground. Position: 2 chains south-south-east of Eldorado.

ii. The shaft is 243 feet deep (also reported that schist was struck at 233 feet, and shaft was continued 3 feet), from it the worked-out ground extends 60 feet west to the "Hope" boundary, along which the face is being carried southwards. Connection has been made with the "True Blue" and "Hope" workings, between which the stope lies.

iii. The workings are now quite dry, though the strata were slightly moist when the shaft was just opened.

iv. The blue country was entered at 100 feet depth, but in the "Hope" adjoining not till 200 feet depth, though there is a small area of oxidised wash at one place in the southern face. It is generally understood that this is the only claim on good gold in which coaly shale does not occur in the cement; but, in the 25-feet north-north-eastern drive connecting with Fraser's workings, a 6-inch bed of sandstone with ⅛-inch coats of coal both above and below, approaches to within 1 inch of bedrock. Beneath it there is good gold, but none in the sandstone itself or in the cement above.

In this claim, when the wash, though otherwise promising, is free from large boulders, the gold is absent, and the miners say "the wash cuts out." Strange to say, it has been proved that the wash is richest where thickest. The run of the thick rich wash has been from north-west to south-east across the stope. In the eastern face about 20 feet south of the shaft nearly all the gold is 2 feet 6 inches above bottom, and in the stope south-west of this run 18 inches of wash on bottom was very poor and most of it was thrown back as filling.

Fraser's run is expected further to the east.

The gold is generally fine, being less than $\frac{1}{10}$-inch in diameter, though one speck of 7 dwt. has been found. It is in thin flakes and arborescent forms, slightly rounded but not waterworn.

Though no pug is found, the bottom has a polished face everywhere that good gold occurs. In the south-western face the partings leave the bottom and run off into the headings, while the bedrock is much broken, and there is then no gold to speak of. It would seem that the faulting died out here.

v. The laminæ of the schist bedrock dip 60° to the west, and when open (separated) good gold is found between them for 1 or 2 inches below the bottom of the wash.

vi. The amount broken down for crushing varies between 2 or 3 inches and 2 or 3 feet (1 oz. at shaft).

A man in the paddock on the surface picks out all the larger boulders and scrubs them in water. If gold is attached, as is mostly the case just now, they are broken up and thrown back, but if none is seen they are cast aside as mentioned elsewhere.

vii. The output* is:—

Jan., 1905: 61 tons crushed for 72 oz. = 1 oz. 3 dwt. per ton.
Mar., 1905: 81 tons crushed for 173 oz. = 2 oz. 3 dwt. per ton.
June, 1905: 117 tons crushed for 207 oz. = 1 oz. 15 dwt. per ton.
Aug., 1905: 84 tons crushed for 105 oz. 14 dwt. = 1 oz. 5 dwt. per ton.

One slug of 3 oz. has been reported, and three or four of 1 oz.

"*Just-in-Time No. 2*" (Lloyd's, Hickey's)—

i. Area: Six men's ground. Position: 3½ chains south-south-east of "Pumpkins."

ii. The shaft is 195 feet deep to the false bottom, and 198 feet 6 inches to bedrock. The ground round the shaft has been stoped out for 5 feet east, 15 feet south, 15 feet west, and 20 feet north-west.

iii. No water was met in the basalt, but water is now oozing out of the cement.

iv. At a depth of 173 feet, 5 feet of quartzite wash, loosely cemented and carrying 1 gr. to the dish of very fine gold, was penetrated. A very slight increase in the contents would render this profitable ground.

The basal wash, like that in the "Eclipse," is tish-like, being composed chiefly of subangular schist, with considerable slightly-rounded quartz, the whole having a reddish tint. It is thus distinct from the ordinary cement of the Ridge.

There is no sharp division between the auriferous wash and the barren 3 feet 6 inches of quartz-bearing tish beneath, though the miners speak of the boundary (sloping about 1 in 10 to the north) as a false bottom. They have, in fact, much trouble in following the gold,

* Warden's return for 1905: 485 tons for 707 oz.

which to the north-west of the shaft has run off flatly into the wash. In addition to this, there is sometimes a 6-inch sandy layer over the wash in the vicinity of which no gold is found.

The gold hitherto won has come principally from a trail running north-westwards through the shaft, and varying from a few inches on the south to 2 feet in width on the north-west. The wash on the trail is 2 or 3 inches thick, and yields 1 and 1½ dwt. to the dish, the prospects off it being only 2 or 3 gr. and less.

vi. For the crushing given below up to 2 feet 6 inches of wash was taken, as gold occurred throughout it.

vii. The output is:—

Sept., 1905: 53 tons 18 cwt., yielding 19½ oz. = 7 dwt. per ton.
Oct., 1905: 22 tons yielding 8 oz. 7 dwt. = 7 dwt. 12 gr. per ton.

(The latter was reported "from the higher level, where there is a large body of wash," presumably that at 173 feet depth.)

"*Last Chance*" (Raynor's, Bedford's).—

i. Area: Six men's ground. Exempt, April, 1905. Position (new): 3½ chains west-north-west of "Bantam."

ii. The first shaft, made too small, was abandoned at a depth of 120 feet, owing to the heavy water met, but Dequine assured me that his party drained the shaft in sinking the "Perseverance." The shaft is now leased as a well by the sawmillers.

The base of the basalt in this shaft dipped 1 in 1 towards the east, though in Dequine's it was dipping towards the west.

The new shaft (5 feet by 2 feet 6 inches) generally known as "Bedford's East," struck wash reported payable at 237 feet depth. The cost of sinking was £118. From this shaft the "Pumpkins" claim-holders are now driving towards their shaft, so that it is possible to examine the workings: a drive extending north-north-east 50 feet, a tortuous drive extending west-north-westwards 70 feet, and the drive in use now reaching a distance of 55 feet to the west-south-west of the shaft.

iv. The wash in the northern drive is hard, and the lower 6 inches (the only part tried by the miners) is barren.

In the southern drive a fault plane dipping 75° east-south-eastwards has been followed from the shaft. This fault shows as a pug seam in the schists, and as a distinct waterline (from which water is now dipping) in the cement. The bottom has been faulted 8 or 9 inches in places, the downthrow being to the south-south-east. The fault was found in the shaft at least 20 feet above bedrock. The fact that a difference is noticeable between the cement on opposite sides of the shaft (it being heavier on the west) would indicate that some lateral movement has taken place.

The best gold has been found along this fault, and in the softer wash in the face prospects of 2 and 3 gr. to the dish are being found, the distribution of the gold, according to the prospecting, being:—

Upper: 2 ft. runs 2 gr. to dish (not tried above.)
Middle: 8 in. runs 4 gr.
Lower: 1 ft. 4 in. runs ½ gr.

The bottom is on the whole very flat, the greatest slope, that at the end of the west-north-western drive, being 1 in 10 to the south. In the northern drive the slope of bottom is 1 in 20 to the north. There are no slickensides between cement and bedrock.

vi. In the west-north-western drive above 12 inches of wash has been broken down.

vii. The only crushing thus far is:—

Feb., 1905: 23½ tons for 11 oz. 10 dwt. = 9½ dwt. per ton.

"*McLoskey's Mistake*" (Herbert's)—

i. Area: Six men's ground. Position: 2 chains south of "Bantam."

ii. The shaft is 230 feet deep. From it a drive extends 20 feet to the north; then the ground east and south-east of the shaft has been stoped out to Heuat's boundary about 20 feet distant; and a stope extends 50 feet south and 120 feet south-west.

iii. When the shaft was first sunk 100 gallons of water per day had to be raised, but the amount gradually diminished till now only a slight seepage at intervals can be detected in the cement. Cracks in the cement were sometimes found to act as reservoirs, but soon ran dry.

iv. The sinking from 175 feet to 226 feet was in coarse conglomerate, and below in the fine conglomerate now worked. The wash is poor when made up of fine gravel, as at the shaft and in the northern drive (where the wash is auriferous only on bedrock, and when containing a few large pebbles). In the present face on the south-west the wash is well waterworn, with much rounded quartz—a good sign in this claim. It is hard and stained reddish, but north-eastwards it changes rather abruptly (25 feet from the shaft) to the ordinary blue cement.

The run of gold, which is taken as about 20 feet wide, is trending somewhat south of west.

Beneath the wash from 18 inches to 2 feet of barren schist-tish fills depressions in the bottom, especially south of the shaft.

"Partings" (slickensides) occur over limited areas both in the wash and on and in bedrock, and in one case above the tish, but the gold is not richer in their vicinity than elsewhere. In the southern face, 35 feet from the shaft, there are greenish "heads" (fissure planes) 6 inches to 1 foot above bottom. There is, however, no gold above them, and little below.

The slope of bottom is slight (1 in 20), and is outwards from the shaft, which has therefore been sunk on a bump. In the south-western drive the slope is again back towards the shaft.

v. The bedrock is schist, the laminæ of which dip south. The leaders in the schist, especially near the wash, appear to be in process of formation; the quartz is sintery and powdery, and the leaders are sometimes cavernous.

vi. The crushing stuff contains very little quartz. An average of 8 inches or 9 inches wash and 3 inches to 5 inches schist was taken east of the shaft; 10 inches total was taken on the south, 12 inches on the south-west.

vii. The output includes:—

From the stope east of the shaft—

Mar., 1905: 52 tons crushed 30 oz. 10 dwt. = 12 dwt. per ton.

From south of the shaft, taking 10 inches total—

June, 1905: 60 tons for 66 oz. = 22 dwt. per ton.

From the present south-western stope, taking about a foot of wash—

Aug., 1905: 52 tons for 101½ oz. = 1 oz. 19 dwt. per ton.

"*Moonshine*" (Campbell's)—

i. Abandoned. Position: 6½ chains south-south-west of "True Blue."

ii. The shaft is 205 (?) feet deep. Some driving was done, but little gold was found.

iii. Output:—

Early in 1905 a small crushing yielded 9½ dwt. per ton,
And in July, 1905, 30 tons (trial) crushed for 5 dwt. per ton.

"*Neiht's*" (No. 88)—

i. Area: Six men's ground. Exempt. Position: 9½ chains north-west of the "Pumpkins."

ii. The shaft is 124 feet deep, and still in basalt.

iii. Very heavy water was struck in the basalt; a flow of 900 gallons an hour was measured, and it is believed it increased to 1,300 gallons, preventing the sinking.

"*Neiht's New*"—

i. Position: 6 chains west-south-west of the "Pumpkins."

ii. The shaft is now (September, 1905) sinking in the basalt.

"*Nipper*" (McGilliivray's)—

i. Area: Six men's ground.

ii. The shaft is 218 feet deep. The first stope (100 feet long and 40 feet wide) is on the "True Blue" boundary, which is 70 feet to the south of the shaft. The gold contents warranted further work to the eastwards, but the face was calculated to be 30 feet below the old flooded workings in McGillivray's Old (or "Mason's") Claim, and it was feared that the water might be tapped. The new stope is reached by a north-north-east drive 35 feet in length; it is 130 feet in length and 40 feet wide, and is being carried eastwards.

A small trail was found just north of the shaft, but it is too poor ($\frac{1}{2}$ oz. per ton) to be worked just yet.

Hand-drills were first introduced here on this field, having been brought over from the Blair Athol coal mines. The machine used is the Conqueror coal borer. It bores satisfactorily in the schist when free from quartz veins (8 holes, each $1\frac{1}{2}$ inches in diameter and 2 feet 6 inches long, in half a shift).

iii. No water.

iv. The wash here is best when coarse. Grey shale occurs in it in the northern workings, about 2 feet above bottom.

In the face of the northern stope there is now good gold 2 feet 6 inches above bottom and adjacent to bedrock, but none about a foot above the bottom. In the same face coaly seams occur in the 12 inches of wash near bottom, and gold is found both above and below them. An overlying 6-inch layer of sandstone and the superimposed "cement" are, however, barren.

McGillivray, who traced the gold from the old Blue Ground, believes that his northern trail runs from the bakehouse on Gowrie Creek, and passes east of "Mason's," but west of the "Fraud," and probably on to "Pengelly's and Young's."

There is no pug on bottom.

The slope of bottom in the northern workings (from scarcely anything to 1 in 10) is westerly and south-westerly, but in the northern drive it is 1 in 12 to the south-south-west.

v. The bedrock is massive schist, dipping 30° to the west-north-west. In it occur east and west cracks, which show evidence of being solution cracks, for good gold is often found in the wash above them, and in the cracks themselves for 2 inches below bottom.

vi. For crushing, 8 to 12 inches wash and 1 to 5 inches bedrock is taken.

vii. The output is:—

Warden's total for 1904: $349\frac{11}{20}$ tons for 261 oz.	= 15 dwt. per ton.
First quarter of 1905: $45\frac{1}{2}$ tons for 34 oz.	= 15 dwt. per ton.
225 tons for 129 oz. $7\frac{1}{2}$ dwt.	= $11\frac{1}{2}$ dwt. per ton.
Aug., 1905: 80 tons for 40 oz. 12 dwt.	= 10 dwt. per ton.
? Sept., 1905: 89 tons for 40 oz.	= 9 dwt. per ton.

Northern Road—

i. Position: 580 paces north 234° east from "Homeward Bound."

ii. The shaft is 30 feet deep.

iii. The sinking was in doubtful kaolinised material, but from the bottom undoubted tish and light reddish schist have been raised. In any case schists can be seen in the creek bed a few chains east of the shaft.

"*Pengelly's and Young's*"—

i. The claim originally contained nine men's ground, but the hitherto disappointing results have caused four men to drop out, and the area has in consequence been reduced.* Position: 4 chains north-north-west of the "Eldorado."

ii. The shaft (2 feet 2 inches by 5 feet) is 243 feet deep. The sinking took 14 weeks, and the cost, exclusive of labour, was £114. Drives were first carried north by west for 35 feet, and west-north-west for 85 feet; and the ground intervening was then stoped out. This part of the workings, having been idle for some time, and being to the dip of the shaft, is to a great extent under water. A face has been carried from the western drive, 8 feet from the shaft, to the "Eldorado" boundary. A prospecting drive, expected to cut the "Nipper" run of gold within 60 feet, is now being carried eastwards from the shaft, with a face 15 feet in width, mullock being stowed up behind in the centre of the drive to produce two air-ways, and thus ensure good ventilation.

The natural ventilation is assisted after shot-firing by hanging a fire-bucket (a perforated oil drum) in the shaft for about three minutes.

The wash has to be blasted down, and Conqueror coal drills are used for boring the holes in the bedrock below the wash.

The present rate of advance of the eastern face is 9 or 10 feet a week, with two shifts.

iii. All the water in these workings comes from below a depth of 192 feet—*i.e.*, it is derived from the cement (conglomerate). The miners have found the flow to be chiefly from east and west "vugs" (cracks). The amount now raised is 100 gallons per twenty-four hours, but it varies considerably according to the state of the weather, being greater or less as the weather is dry or moist. The water is potable, having only a very slight sweetish taste.

iv. The wash or cement is the normal basal conglomerate of the Black Ridge, being composed of rounded pebbles and boulders (up to several hundred pounds in weight in the case of the granite) of schist, quartz, granite, quartzite, "pilot-stone," &c., and having a prevailing neutral tint.

It is reported that the best gold follows the granite boulders, but this may be more apparent than real, the gold being more apt to remain attached to the rough granite than to the smooth stones in the surrounding wash.

The "cement," as is general on the field, proved very poor where sandy—*e.g.*, along the "Eldorado" boundary south-east of the shaft, and in the faces north-west of the shaft, where a drive was continued 12 feet into it.

A fact of considerable importance was here first pointed out to me—viz., the occurrence of gold in the wash some feet above bottom,

* Rechristened "New Perseverance."

where the wash is almost or quite barren. Some 25 feet south of the shaft only a foot of cement has been tried, but it is confidently expected that the "headings" will prove richer.

A band of coaly shale, 3 or 4 inches thick, occurs in the cement, usually about 3 feet from the bottom, dipping, in the southern workings where exposed, at an angle of 5° to the west. As elsewhere indicated, the coaly seam near the base of the cement seems to have exercised some controlling influence on the deposition of the gold, yet the following section was observed on the "Eldorado" boundary south-west of the shaft:—

Roof: Coaly shale.
12 in.: Cement poor in gold.
12 in.: Cement richly auriferous (containing two-thirds of gold contents).
15 to 18 in.: Cement containing ½ gr. to 1 gr. to the dish.

The whole of the 3 feet 6 inches, when crushed, yielded an average of ½-oz. gold per ton.

As to the runs of gold, the ground on the northern side of the shaft is poor, while that on the southern was worth breaking down—giving prospects of ¼-dwt. to the dish, which is equivalent to 1½ oz. per ton. The edge of this run was along the north-western drive. It is expected that a run will shortly be met in the eastern drive, the latest prospects (14th September) being 4 gr. to the dish (1oz. to ton). The northern run in the "Nipper" is believed to be bending towards this claim.

It should also be noted that there is no pug between wash and bottom, the latter being, however, roughly grooved or troughed by the extension of the tougher or harder laminæ of bedrock. There is only occasional, very slight, and inconclusive evidence of movements between the coal measure and the schist here (south of the shaft). The slope of bottom varies between 1 in 10 and 1 in 20 to the west.

v. Thick-bedded schists occur beneath the wash, dipping westwards at a slightly greater angle than the coal measures. These are crossed by north-east, south-east, and east and west cracks. In places the schists are more fissile, and seamed with lenticular strings of quartz, lying parallel to the laminæ of the rock. My own observations seem to show (though they are not sufficiently exhaustive) that these leaders taper out towards the cement, often bending over at the bottom of that rock. This would tend to prove that the leaders are younger than the wash, which, however, they never penetrate. It is unanimously acknowledged on the field that these leaders never carry gold except on the cracks within a few inches of bottom, as is the case to a lesser extent with the bedrock itself.

There are, however, in addition to these intercalated leaders, occasional east and west leaders on vertical cracks, one of which, south-west of the shaft, was said to have carried a little gold in the solid, 2 feet below bottom. None of the quartz carrying gold could be shown me, that seen containing only pyrite, lining cracks.

Photo., L.C.B. PENGELLY'S AND YOUNG'S, BLACK RIDGE. **Plate 6.**

SHOWING PADDOCK OF CRUSHING STUFF AND REJECTED BOULDERS.

vi. The practice here has been to break down from 12 inches to 3 feet 6 inches wash with 6 inches bedrock, though in the eastern drive no bedrock is taken, owing to the poverty of the ground. There is, however, a distinct improvement in the face 62 feet from the shaft.

The whole of the material crushed previously to September came from west of the shaft.

vi. The stone crushed does not represent the whole showing in the face, for in the first place the larger boulders remain below, and in the second a greater or less proportion, according to the poorness or richness of the wash, is thrown out of the paddock by the bracemen. In this claim the stones thrown aside at the surface amount to 8 cwt. for every ton sent to the battery (Plate 6).

vii. The output* comprises:—

1904, Dec.:	38 tons for 18 oz.	=	9½ dwt. per ton.
1905, Feb.:	36½ tons for 28 oz.	=	15 dwt. per ton.
Mar.:	76½ tons for 74 oz.	=	19 dwt. per ton.
May:	20 tons (mullock) for 1 oz. 9 dwt.	=	1½ dwt. per ton.
Jun.:	102½ tons for 52 oz. 5 dwt.	=	10 dwt. per ton.
July:	58 tons (from S.W.) for 31 oz. 15 dwt.	=	11 dwt. per ton.
Aug.:	58 tons for 17 oz. 12 dwt.	=	6 dwt. per ton.
Oct.:	46 tons for 9 oz. 16 dwt.	=	4 dwt. per ton.

The June crushing contained slugs up to 1 oz. in weight. The August crushing, according to the *Peak Downs Telegram*, just paid battery and claim expenses.

"*Perseverance*" (Dequine's)—

i. Exempt. Position: 7½ chains north-north-west of "Pumpkins."

ii. The shaft is 150 feet deep, and is understood to have reached beneath the basalt, having been abandoned in clay and sand.

iii. Great trouble was caused by the large quantity of water met with—2,000 gallons an hour—causing such a pressure in the loose material under the basalt that 8-inch timbers were crushed. Mr. Dequine informed me that three distinct water-bearing zones were pierced in this claim. The first, spongy basalt at 115 feet; the second, jointed undecomposed basalt at 138 feet; and the third, spongy basalt at 150 feet. According to the slope in the "Last Chance," the base of the basalt should have been struck at considerably less depth.

"*Pumpkins*" (Madge's)—

i. Area: Six men's ground. Position: 4½ chains west-south-west of "Bantam."

ii. The shaft is, according to Madge, 218 feet to bedrock, but, according to others, only 211 feet.

The main drive runs 30 feet north-north-eastwards from the shaft to the stopes, which extend 25 feet westwards and 80 feet eastwards, with widths of 30 feet on the west, 15 feet near the main drive, and 55 feet in the eastern part. The remaining drives include one from the shaft to the western end of the stopes, a second and third, 20 feet and

* The Warden's return for 1905 is: 410 tons, £908.

25 feet in length, to the south at the eastern end, and a fourth, extending 60 feet north-north-eastwards, also from the eastern end of the stopes.

The last was being pushed out towards "Bedford's Eastern" shaft ("Last Chance"), but, on account of the long uphill trucking to the "Pumpkins" shaft, the claimholders prefer to work the ground from the "Last Chance."

iii. A small quantity of water (75 gallons a day) makes in the shaft, and it is expected that the northern drive will be flooded by the time connection is made with the "Last Chance."

iv. In the shaft 12 inches of almost barren conglomerate occurs under coal shale, 2 feet 6 inches above bedrock, but this is nearly 5 feet above the main basal auriferous conglomerate. Coaly shale occurs in the strata immediately overlying the wash, and in the north-north-eastern drive from the shaft 2 feet 6 inches of tish, with shale bands, has been exposed beneath the coaly shale.

The wash is of a bluish colour, but much of it has a slight coating of red oxide of iron.

The run of gold worked is believed to be the southern "Bantam," the northern run of the "Bantam" being presumably between the "Pumpkins" and "Last Chance."

It is understood that the western, northern, and eastern faces of the stopes are not rich, but they have not been properly prospected by driving. The southern and northern drives were put in to prospect the ground, but cannot be considered to have served the purpose, though gold has been found in the faces. In the former the lower 6 inches of wash has been tried in the end only, and in the latter no greater thickness has been tried. Payable gold has now been found in the northern drive, 40 feet from the stope.

South of the shaft the bottom seems to be sloping south-eastwards, while the coal measures dip south-westwards. The general slope of bottom is north-eastwards at about 15°, but in the eastern workings it is more nearly eastwards, and is as much as 1 in 2. In the face of the northern drive it is, however, 1 in 10 to the north-east.

v. The bedrock is schist, foliated and quartz-veined parallel to the bottom. The quartz veins are never auriferous, but, like the pebbles of the wash, are sometimes slightly iron-stained.

vi. The amount of wash broken down for treatment has varied from less than a foot to 6 feet (in the eastern stope). In one or two places 12 or 15 inches of wash on bottom, being almost barren, was left untouched, while that above was removed.

vii. Output*:—

Warden's total for 1904 :	97	tons for	307 oz.	= 3 oz. 3 dwt. per ton.
Feb., 1905 :	45½	tons for	51 oz.	= 1 oz. 1 dwt. per ton.
P.D. Tele., Apr., 1905 :	62	tons for	33 oz.	= 11 dwt. per ton.
July, 1905 :	59	tons for	30 oz. 16 dwt.	= 10½ dwt. per ton.
Sept., 1905 :	27	tons for	22 oz. 6 dwt.	= 16½ dwt. per ton.

* Warden's total (?) for 1905 : 230 tons for 163 oz. 0 dwt. 6 gr.

"*Rejected*" (Moor's or "Dee")—

i. Position: 2 chains south of "Pumpkins."

ii. The shaft bottomed at 221 feet. A drive was first opened about 20 feet to the south-east, rising in the face about 18 inches above the shaft bottom. Another was then carried north-west for 12 feet on the level; then 15 feet, rising 1 in 5; and then 10 feet, rising 1 in 3.

The party now intends to break through to Madge's old stopes, working on both claims.

iii. Water was struck in the shaft at 166 feet depth, but there is none in the tish.

iv. The sinking included:—Basalt, 80 feet; various sediments, 110 feet; quartzite wash (carrying 1 gr. to the dish), 2 feet; sediments, 8 feet; "drift wash" (carrying ½ to 1½ gr. to dish), 4 feet; tish (schist and quartz fragments and pebbles, with only fine colours of gold), 21 feet.

Both the quartzite wash and "drift wash" carried gold, the latter being the richer. A heap containing about 5 cwt. of stone, said to have come from the former, lay on the brace; from it 18 gr. of gold had been dry-blown, and it was expected that almost as much more would be obtained after crushing it, in which case the contents would be 5 dwt. per ton. The occurrence of gold in these layers may have a connection with the fault at the shaft bottom. In case of the wash on bedrock proving unpayable, it is intended to go up the shaft and try these layers.*

At the shaft bottom is a pug seam, 1 inch thick, separating the tish from the bedrock, the surface of which is quite glossy, proving it to be a fault plane. The fault dips 1 in 6 to the south-south-west at the shaft, but within 10 feet to the north-east it suddenly rises and passes into the reef at an angle of 1 in 1.

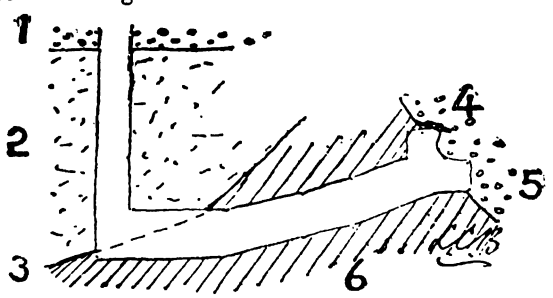

FIG. 4.—SECTION ON NORTHERN DRIVE, "REJECTED," BLACK RIDGE.

Scale: 20 ft to an inch.

1. Sedimentaries.	*4. Sediment.*
2. "Tish."	*5. Wash.*
3. Fault.	*6. Schist.*

In the end of the northern drive bluish cement, containing water-worn quartz with red iron stains, underlying a bluish sediment, and

* Warden's return for 1905 is: 30 tons for 45 oz. 6 dwt.

overlying tish (?), has been broken into. This lies on an unslickensided sidling, sloping 50° to the north-north-east, and for 18 inches from the schist has been proved to be slightly auriferous (1 to 2 gr. to the dish), and a 1-dwt. speck has been found. The miners, however, do not expect the wash to be rich on such a steep sidling—payable gold, in fact, not being expected much above the level of that in the "Pumpkins." (*See* Fig. 4.)

"*Rip and Tear*"—(Lloydstrom's)—

i. Area: Six men's ground. Exempt. Position: 8 chains north-west by west of "Pumpkins."

ii. The shaft, in May, 1905, was reported to be 115 feet deep.

iii. The shaft was abandoned while still in basalt, owing to the excessive quantity of water met with (1,500 gallons per hour), and is now used as a stock well.

"*Ruby*" (Wyles)—

i. Area: Six men's ground. Exempt. Position: 12½ chains north-west of "Pumpkins."

ii. The shaft is now 117 feet deep, and had to be abandoned because the water proved too strong.

iii. In February, 1905, the water, flowing into the shaft at 95 feet depth, amounted to 120 gallons per nine minutes.

iv. The sinking appears, to judge by the tip, to have been first in dense basalt, and then in vesicular and somewhat decomposed basalt, with a slight development of amygdaloids.

"*Southern Cross*" (Connorty's, Smith's, and Topham's)—

i. Area: Six men's ground. Position: 13½ chains north-west of the "Pumpkins."

ii. The shaft, now inaccessible, is 228 feet deep (bedrock at 220 feet). At 200 feet depth the sinking was by pickwork. A drive was carried 35 feet (?) north-easterly to the dip, on to a terrace 10 feet below the shaft.

iii. No water was met in sinking.

iv. There is no coaly shale above the wash in the shaft.

Colours of gold were found in July, 1905, but there seems to have been little or no wash, and, to judge from the stone on the tip, work must have stopped in a brownish "tish."

A high "bar" lies to the west of the shaft.

"*Star of the South*" (Voinech's)—

i. Position: 6½ chains south of "Pumpkins."

ii. The shaft is now (September, 1905) 75 feet deep.

iv. It is still in basalt, weathering into rounded boulders which give much trouble in shooting.

"*Try Again*" (Bedford's New)—

i. Position: 8½ chains south-west of "Pumpkins."

ii. The shaft is now (September, 1905) a little over 100 feet deep.

iii. Water was struck (a few gallons an hour) just before I left the field.

iv. The sinking near the surface was in vesicular basalt; below that in shaly basalt, passing downwards gradually at about 50 feet into the solid undecomposed rock.

"*True Blue*" (Fraser's)—

i. Position: 2½ chains south-west of the "Nipper."

ii. The shaft is 235 feet deep, bedrock being at 223 feet. The sinking took three months' time, and entailed an expenditure per man of £16, besides labour.

The old workings (now abandoned) run 30 feet to the south-east, being 25 feet across in the face (to be worked in the future); and from there a 60-feet drive connects with the "Nipper" working for ventilation. The new workings are on the "Eldorado" boundary, 130 feet west-south-west of the shaft, with which they connected by a drive. On the north they are 20 feet in width, but 65 feet to the south; the present face is 60 feet long. There is another small stope, 30 feet wide and 40 feet long, on the western drive near the shaft. Further work will be done along this drive, where good prospects have been obtained.

iii. No water.

iv. A coaly band occurs in the wash 2 feet above bottom in the western drive, and the gold is believed to be above it. A sandy shale, with thin lines of coal, about 6 inches above bottom, besides having gold beneath it, generally acts as a false bottom. In one place in the new face the coaly shale band comes right down on to bedrock, and the wash cuts out, but the 4 or 5 inches of schist below bottom carries very good gold, and gold was found in the wash when the shale rose again.

Among the rejected boulders can be detected tish, spotted schist, and quartz (amounting to only 2½ per cent. at most), the average size being 9 inches length and 6 inches across.

The "Nipper" run of gold is expected to be cut by working easterly from the old workings.

The slope of bottom was as much as 1 in 10 to the north-north-west (in the old workings), and 1 in 15 to the west-north-west (in the new workings).

v. The bedrock is thick-bedded, slaty schist, dipping 45° to 50° to the north-west. In the old stope, 40 feet to the south-east of the shaft, the bedrock has suffered disturbance since the solidification of the wash. Incipient faulting, with considerable contortion of the schist and disturbance of the bottom, has occurred, causing "dig" in places. (*See* Fig. 5.) The fault dips 50° to the west-north-west. In the new workings the bottom has in one place been much contorted, broken up,

and, for about a foot beneath the wash, veined with lenticules of quartz. It is due to crushing having taken place since the solidification of the wash, and the lenticular veinlets of quartz have been developed since the crushing of the slates.

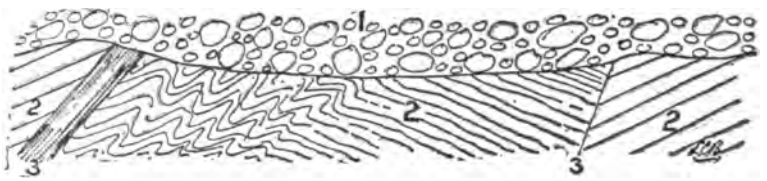

FIG. 5.—FAULT IN "TRUE BLUE," BLACK RIDGE.

Scale: 40 ft. to an inch.

1. Wash.
2. Schists
3. Faults.

vi. The thicknesses broken down are: 18 inches wash and 3 inches solid bedrock in the old workings south-east of the shaft. In the new workings up to 18 inches is rich in gold, and 2 feet of wash is taken, when there is a slickensided sediment above (forming a good roof); 6 or 8 inches of softened bedrock is generally taken, though of the harder rock sometimes only 1 or 2 inches.

vii. Output* :—

1904, Feb. : 50 tons for 42 oz. = 17 dwt. per ton (S. of shaft).
Mar.: 56 tons for 46½ oz. = 16 dwt. per ton (S.W. of shaft).
May: 76 tons for 53 oz. = 14 dwt. per ton (W. and S.W. of shaft).
Sep.: 81 tons for 49 oz. = 12¼ dwt. per ton (drive to "Nipper").
76 tons for 125 oz. = 1 oz. 13 dwt. per ton.
Dec.: 68 tons for 154 oz. = 2 oz. 5 dwt. per ton.

Warden's total for 1904 : $400\frac{4}{25}$ tons for 460 oz. 12 dwt. = 1 oz. 3 dwt. per ton.
1905, Jun.: 196 tons for 281½ oz. = 1 oz. 9 dwt. per ton.
July: 68 tons for 80½ oz. = 1 oz. 4 dwt. per ton.
Sep.: 119 tons for 122 oz. 13 dwt. = 1 oz. 1 dwt. per ton.
Oct.: 78 tons for 42 oz. = 11 dwt. per ton.

"*Waratah*" (Ford's)—

i. Exempt. Position: 8 chains south of "Nipper."

ii. The shaft is 208 feet deep, and there is a 30-feet drive. Inaccessible.

iii. Some water was met in sinking.

iv. Only occasional prospects were found in the wash, of which 8 inches was tried.

vii. No crushings. Dry-blowing headings (September, 1905).

2. OLD CRICKET GROUND.

Several claims are working, but the ground is understood to be getting cut out.

"*Dan Carroll's*"—

ii. Driving eastwards.

* Warden's total for 1905 is: 624 tons for 660 oz.

iv. Good gold. One 19½-dwt. "speck," which still contained a small proportion of attached quartz, was shown me. Such specimens are characteristic of the Cricket Ground, while towards Daintree's Knob the gold is much finer.

3. Hillside Claims.

"*McCallum's*" (or Ford's)—

i. Abandoned. Position: 4 chains north 162° east from the Black Ridge Hotel.

ii. The shaft is 145 feet deep. Much work has been done in this claim during the past year.

The mine is now again idle, because of the faces becoming poor, but payable ground is expected on opening out, say towards the "Fraud."

vii. Output:—

Probably 350 tons washed for yields up to 16 dwt.

"*Moxham's Leap*"—

i. Position: 19 chains north-north-east of the "Nipper."

ii. The shaft is 185 feet deep.

vii. Output: The first load was washed for 11 dwt., and several loads were washed for 5 to 7 dwt. These had to be troughed and broken with a beater. No wash has been raised since the above, but the headings were being dry blown in September, 1905.

4. Blue Ground.

The latest developments have been along Gowrie Creek, on part of the old Blue Ground, which at the time of my last visit was untried. Some six claims have been taken up in a line running towards Daintree's Knob. They have brought to light an extensive fault, which I was able to inspect in "Edwards and Ford's" claim.

It is said that the east and west trails which were followed in the Red Ground broke up in the Blue Ground on passing beneath Gowrie Creek, as at the Wild Cat and Deep Creek (McDonald's Flat).

"*Williamson's*" (and Fogarty's)—

i. Position: 3 chains north-north-east of the Billiard Saloon.

iv. Fair prospects.

"*Donaldson's*"—

i. Position: 1½ chains east of the Billiard Saloon, on Gowrie Creek.

ii. The shaft is 95 feet deep.

"*Maisey's*"—

i. Position: 5 chains south-east of Donaldson's.

iv. The sinking included 16 feet of billy. The workings are believed to be on a separate trail to "Edward's and Ford's," described below.

vii. Output (among others):—

Aug., 1905: 16 loads puddled for 8 oz. 9 dwt. = 10½ dwt. per load.

"*Popplewell's*"—

i. Position: 5 chains south-east of the New Bakery.

ii. The shaft is 115 (?) feet deep.

iv. The wash here, being cemented, has to be crushed.

vii. Output:—

July, 1905: 23 tons = 21 dwt. per ton.
Aug., 1905: 45 tons for 80 oz. = 38 dwt. per ton.

"*Edward's and Ford's*"—

i. Position: About 5 chains south 10° degrees east of the New Bakery.

ii. The shaft is 111 feet deep to bedrock, and 5 feet 6 inches into bedrock. A drive runs west for 20 feet in hard, rather sandy, barren blue cement. A few tons have been removed on the northern side of the shaft. A drive (50 feet long in September, 1905) is now being carried out to the east-south-east from it at 20 feet from the shaft, a cross-drive runs 10 feet to the north, and a branch from the end runs back 10 feet towards the shaft.

iv. The sinking comprised: Clay, 10 feet; billy, 10 feet 6 inches; billy sand (with holes, one 20 feet long, 4 feet high, and 18 inches wide, with jagged and loose stones on the sides), 6 feet; soft sands, 25 feet; and conglomerate, to 111 feet. The eastern drive is in schist for 20 feet from the shaft, when it enters wash overlaid by schist. This is due to a fault running south 10° east, and dipping westwards 1 in 2 (?), causing an upthrow of some 12 feet on the west. (*See* Fig. 6.) The slope of bottom is 1 in 20 to the north-west. The plane of the fault is not slickensided, but the laminated schist has been broken up into a kind of puggy tish for from 18 inches to 2 feet from it. The fault has been found in other claims for 5 chains to the south 10° east.

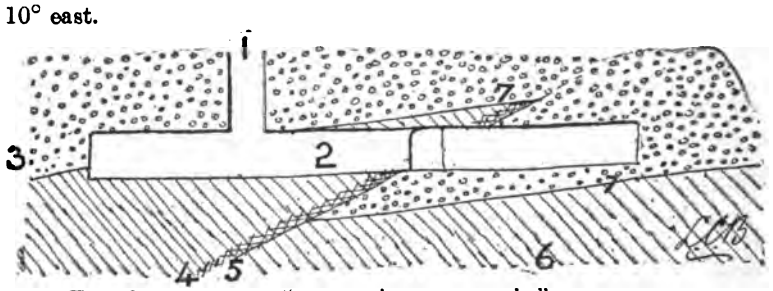

FIG. 6.—FAULT IN "EDWARD'S AND FORD'S," BLACK RIDGE.

Scale: 25 ft. to an inch.

1. Shaft.
2. Drive.
3. Wash.
4. Tish.
5. Fault.
6. Schists.
7. Gold.

A little gold, but unpayable, is found on the fault; ½ to 2 gr. to the dish is found on the (upper) bottom west of the fault, but none near the fault on (the lower) bottom east of it. At 30 feet east of the fault, however, gold is being got on bottom, and is expected to increase eastwards.

v. Bedrock is bluish schist, the laminæ of which dip steeply eastwards.

vii. The tenor of the wash has not yet warranted a crushing.

5. Daintree's Knob.

"*Carroll's*"—

ii. A face now being cleaned up is expected to run 15 dwt. per ton.

vii. Hickey's crushing, given by the Warden as from Mason's (Bedford's old), on the Deep Ground, is from this claim.

"*Monahan's*"—

i. At head of Gowrie Creek.

ii. The shaft is 136 feet deep.

vii. Output:—

May, 1905: 23 tons for 11 oz. = 9½ dwt. per ton.

IV. MICLERE CLAIMS.

Population: Between 1891 and 1895 there were nearly 400 men at the Miclere; at present, on the Tish Ground, there are six men, and on Boulder Gully the same number. The total at Miclere is now between fifty and sixty men.

Cracks in bedrock are reported to be often gaping when first exposed in the old workings.

"*Smither's and Barker's*"—

i. The shaft lies a few chains west of Palmer's and Reid's.

ii. The shaft is 63 feet deep, and was abandoned soon after sinking, through flooding from the old workings.

iv. A fault lined with ½-inch pug in the wash and schist here runs south 10° degrees east, dipping 80° to the west. It is reported that in some of the claims the western side has been thrown up 28 feet, so that there is an overhanging ledge of bedrock. (*See* Fig. 7.)

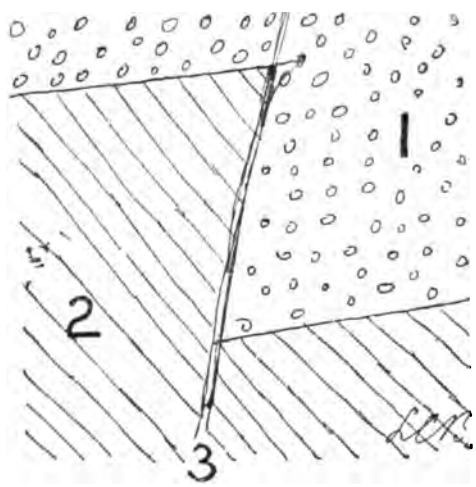

Fig. 7.—Fault in "Smither's and Baker's," Miclere

Scale: 20 ft. to an inch.

1. Wash.
2. Schist.
3. Fault.

Good gold has been found all along this fault (the ground elsewhere being patchy) for 5 or 6 feet from bottom; and "colours" have been found right to the surface.

There is no pug on bottom.

vii. Output:—100 oz. of gold were obtained from 5 bucketsful of dirt from along the fissure.

1. "Tish" Ground (Coal Measures).

"*Palmer's and Reid's*" (Gillespie's Old)—

i. Position: 1 chain north of Madge's, and east-south-east of the Post Office.

ii. The shaft is 91 feet deep, and, as only just unwatered, it was not inspected. The solid ground on the north-eastern side of Madge's worked ground is being tried, but none has been taken out yet.

iv. The slope is about 1 in 20 to the south-west.

"*Roper's*"—

i. Position: Two shafts (now filled in), one on each side of the road (and about 10 chains apart), 1½ miles south of the Miclere.

ii. The eastern shaft is 75 feet deep, sunk in loose white quartz conglomerate, beneath pebbly surface, with billy caps. The western shaft is 80 feet deep in white conglomerate and sandstone.

iv. Neither shaft bottomed, work being abandoned as soon as the country became too hard for picking.

2. Boulder Gully.

Gold is now being found in "dabs" in clay, under billy boulders, at 6 feet below the surface.

Two shafts bottomed on schist at 60 and 90 feet, but the wash carried only colours of gold.

24th October, 1905.

Appendix.

The following references to gold-bearing conglomerates have (except those of New South Wales and Queensland) been extracted from Beck's and Weed's "Nature of Ore Deposits" just to hand. They show that the Black Ridge deposits are not unique in form, and that the theory of origin offered above has been already proposed elsewhere.

Black Hills, Dakota.*—"Cement deposits (3 to 4 feet of rounded waterworn fragments of schist) of the basal conglomerates of the Cambrian beds, resting directly upon upturned schists." The gold is rounded, and the greater part is derived from the Homestake lode, but films between the fracture planes of the schist are due to enrichment by ferric sulphate solutions and to the introduction of pyrite following rhyolite intrusions.

Gulgong, N.S.W.†—"Detrital gold in payable quantities" in conglomerates forming the basal beds of the Upper Coal Measures (Permo-Carboniferous)—1 to 15 dwt. gold per ton. "Doubtful whether this deposit forms a definite alluvial lead." "The conglomerates were, doubtless, deposited in an estuary, and it is probable that the auriferous portions of them were laid down along the shore line which received the surface drainage from some old auriferous rocks, and that the gold derived from the denudation of the latter was thus distributed amongst the pebbles."

Mount Brown, N.S.W.†—A lead composed chiefly of waterworn white quartz lies on Silurian rocks, and is found to dip beneath the surface of the plain, which is formed of Desert Sandstone (U. Cretaceous). Some very rich patches of gold.

Drake, N.S.W.†—The conglomerates forming the base of the Clarence River Coal Measures (Triassic) contain detrital gold, though not in payable amount.

Hobart, Tas.—Gold has been found in the Coal Measures here.

Corbett's Mills, Nova Scotia.—Rounded gold grains in Carboniferous conglomerate traversed by gold-quartz strings.

Bessèges, France.—Gold has been extracted from Lower Carboniferous conglomerate.

Placer Co., California.‡—Auriferous Jurassic conglomerates, finely divided gold with some pyrite, possibly due to later impregnation.

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* Papers by W. B. Devereux and F. C. Smith in Trans. Am. Inst. Min. Eng., and official reports by J. D. Irving and S. F. Emmons of the U.S. Geol. Survey.

† Edward F. Pittman: "Min. Resources of N.S.W."

‡ Lindgren: Am. Jour. Sci.

Northern California.—Gold-bearing Mesozoic conglomerate of marine origin.

Otago, *Nelson*, and *Southerland*, N.Z.*—Auriferous deposits of Cretaceous age.

Ipswich, Q.—Mr. Cameron, of this Survey, informs me that there have been reports of gold occurring in the basal beds of the Ipswich (Trias-Jura) Coal Measures.

Callide, Q.—Gold occurs in the fine-grained basal conglomerates of the Callide (Trias-Jura) Coal Measures, and a little prospecting has been done on Kelly's Gully for, however, very poor returns. The conglomerates are many feet in thickness, and gold appears to have been found at various horizons in them. Basalt occurs in the vicinity sometimes abutting against the conglomerates, and may have been connected with the introduction of the gold. Further prospecting is likely to be done here.

Palmer Goldfield, Q.†—"Payable gold has been obtained in consolidated drifts or 'cements' between the base of the Desert Sandstone (U. Cretaceous) and the surface of the slates, to the north of the Palmer."

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* H. A. Gordon: Trans. Am. Inst. Min. Eng.
† R. L. Jack: "Geology of Queensland."

INDEX.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane

Queensland.

DEPARTMENT OF MINES.

Geological Survey of Queensland.

PUBLICATION No. 102.

SOME

CROYDON GOLD MINES

WITH 14 PLANS AND 12 PLATES.

BY

B. DUNSTAN, F.G.S.,
ACTING GOVERNMENT GEOLOGIST.

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SOME CROYDON GOLD MINES.

INTRODUCTION.

In making a detailed investigation of the geological and mineral features associated with the Golden Gate line of reef on the Croydon Goldfield, the special objects in view were to inquire into the probability of finding gold in various places along the line of reef, and to advise those interested on the prospects of striking gold-bearing reefs if sinking were continued to greater depths. The results of this work, together with a large number of plans of the mines on the Golden Gate reef, are given in the present report.

A prior report on the Croydon Goldfield, by Mr. W. H. Rands, was published by the Geological Survey Office in 1896, and will be found to contain a large amount of useful information on gold-mining at Croydon up to that time. It also gives an outline of the known geological formations, and of the gold-prospecting operations in the surrounding country.*

Golden Gate township is situated about four miles from Croydon, in a north-westerly direction, the position of Croydon being Lat. 18° 12′ 13″ south, and Long. 142° 14′ 58″ east.

Croydon and Golden Gate are on the extreme eastern edge of the vast plain extending towards the Gulf of Carpentaria and the western boundary of Queensland, the country to the east being hilly and mountainous, and extending uninterruptedly in this direction for many miles.

The streams which have their source in the Croydon district fall either westerly or northerly. Some of those trending westerly rise in the hills immediately to the north of Croydon, while others rise in the low granite country to the east of Croydon, all disappearing in the western plains, the porous rocks of which form the intake beds of the artesian series belonging to the Cretaceous System. The watercourses flowing northerly have their source also in the hilly country, but are some distance further north from Croydon than those trending westerly, and they fall into the Carron River, a branch of the Norman River.

Timber does not grow well in the Croydon district, and for mining, as well as for domestic purposes, localities on the Croydon-Normanton railway line have to be depended upon for the requisite supply.

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* Report on the Croydon Goldfield. W. H. R. By Auth.: Brisb.: 1896. Pp 66, 3 maps, and 11 plates. (G.S.Q.P., No. 118.)

Golden Gate lies at the base of the very gentle westerly slopes of a series of hills from one to three miles distant. The principal elevation is Black Mountain, which lies about three miles to the west of the Golden Gate Railway Station, and has an altitude of 724 feet. Cuthbert Hill is the name here given to the conspicuous feature in the landscape east of the main road between Golden Gate and Croydon, and on the north side of Belmore or Station Creek. Double Peak lies to the north of Black Mountain, and about east of the Golden Gate township. Plant's Hill is the name given to the elevation between Double Creek and Golden Gate, the deep shaft, known as Plant's shaft, being sunk at the bottom of the slope leading down from it.

Robinson's Hill is a prominence north-east of the Golden Gate, and is about a mile and a-half distant. Two other small hillocks, about a mile west of Robinson's Hill, and about the same distance northerly from Golden Gate, have been called "Felsite Knobs." The exact position of these landscape features, together with their altitudes and configuration, are shown on the accompanying plan (No. 1), on a scale of ten chains to an inch.

The principal stream at Golden Gate is Belmore (or Station) Creek, the main heads of which have their source several miles away to the north-east of Croydon. Golden Gate Creek is a small watercourse on the north end of Golden Gate, while another watercourse, called Rogers' Gully, which takes its rise at Double Peak, has a southwest course, and disappears in the flat country to the west of the railway line.

GENERAL GEOLOGICAL FEATURES.

The topographical features and geological formations at Croydon and Golden Gate have been proved to bear a direct relation to one another, the hills being composed of felsite and quartz felsite, while the flat country, which forms the covering of a large area of granite, consists of horizontally bedded and undisturbed conglomerates, ferruginous sandstones, and cements.

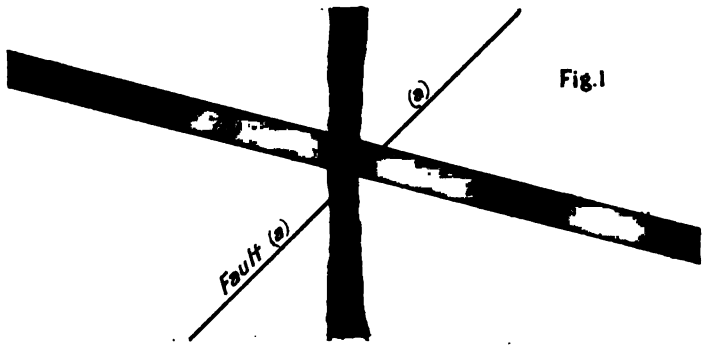
Below the conglomerates and sandstones the granite is to be found all over the Croydon Goldfield, but in no place have the sedimentary rocks been observed having a thickness greater than twenty feet. Away from the hilly felsite country, very probably the depth at which the granite occurs will be greater as the distance therefrom increases, with, of course, a corresponding increase in the thickness of the sandstones and conglomerates.

Felsites.

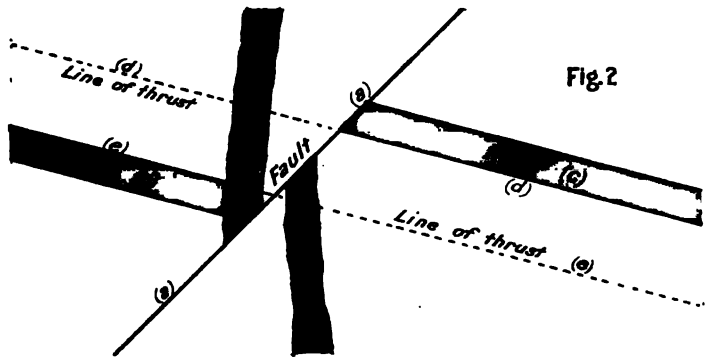
The felsites are conspicuous rocks in the mountainous country to the north-east of Croydon and Golden Gate, but they are absent from the low country, where the granites occasionally outcrop above the

Diagramatic Sections

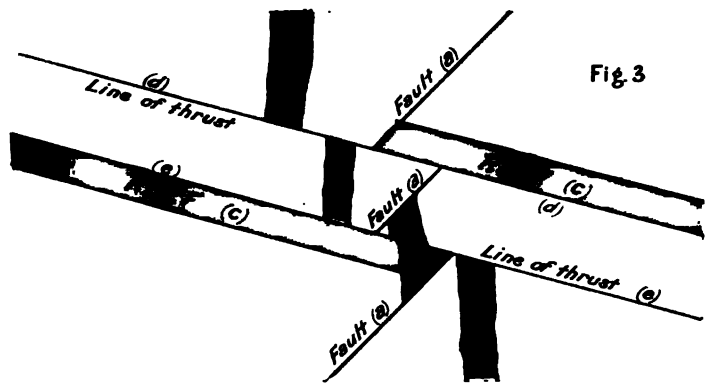
Illustrating the successive movements in the faulting of the Gate Reef
West of the V. Shaft in the G.G.4 & 5 S. Block
& near the boundary of the Nº 3 & 4 S.



Joint Plane *(a)* passing through Reef and Dyke



Normal faulting along the Plane *(a)*



Reversed faulting, or thrust, along the two Planes *(d)* & *(e)*

(Illustrating Report on "Some Croydon Gold Mines")

horizontally-bedded sandstones and conglomerates. Some of the felsites and quartz-felsites merge into a fine-grained porphyrite, while others, from the alteration which they have undergone, are of indefinite composition. This is particularly noticeable close to the junction of the felsites and granite, where a zone of alteration exists, and where the rocks vary much in character. The replacement of some of the minerals with silica, and the alteration of the felspars to kaolin, and of the ferro-magnesian to chloritic and serpentinous matter, makes the microscopic examination of the rocks one of uncertainty.

In the following pages they will be referred to generally as felsites, and may be identified in the field as bluish fine-grained rocks, and which on the surface are sometimes decomposed to a whitish or reddish rock resembling a fine-grained sandstone. Occasionally large blebs of quartz occur in the felsites, but usually they are without these inclusions. Graphite (plumbago) is found disseminated through the felsite, but the amount is exceedingly small, although the quality of the mineral is very pure.

The occurrence of the felsites, more or less altered or decomposed, has been observed in many localities in the district, but conspicuously are they to be seen at the Felsite Knobs, Robinson's Hill, Double Peak, Cuthbert Hill, and Black Mountain. (*See* Plan 1.) In the immediate vicinity of Golden Gate the reefs in the felsites are not productive, but some miles distant from their junction with the granite they have proved in places to be very richly impregnated with gold.

Dykes of felsite have been observed in the granite forming the walls of the Golden Gate Reef, where their presence was considered to influence the occurrence of the gold in the quartz. Nothing, however, was seen to warrant this conclusion being drawn.

A vertical section across the hills and flat country is represented on Plate 12, and shows the relation of the felsite to the granite. From the evidence obtained it would appear that the granite underlies the felsite, and that the former rock is dipping easterly under the felsite hills.

Granites.

The granites are confined to the low country, where they are exposed cropping up above the horizontally-bedded sandstones and conglomerates, and also in the watercourses which have cut a channel through the latter rocks. Wherever found, even at a depth of over 1,300 feet from the surface, they are altered, the ferro-magnesian constituent seldom being recognisable.

In the field they are observed as close-grained rocks, generally with a pink or grey felspar and limpid quartz, and containing a dark-greenish product resulting from the alteration of hornblende or mica.

Inclusions of graphite are common, but this mineral in the granites, unlike that in the felsites, is very impure, and is mixed with much quartz. The alterations of the original constituents of the granite have produced several secondary minerals, those most noticeable being greenish-yellow serpentinous matter, a white flaky calcite, a whitish or pink fluorspar, and a brown siderite; while impregnations of mineral solutions have resulted in the formation in the rocks of iron pyrites, copper pyrites, galena, and arsenical pyrites in small quantities.

The general mining development along the line of the Golden Gate Reef indicates the division of the granite into more or less defined belts, depending on the absence or presence of graphite. Another division may be distinguished by the texture of the mineral constituents, fine and coarse varieties occurring along certain zones. The coarse variety is usually taken to be an intrusive dyke, but the large area of this rock, both at Golden Gate and at Croydon, and also in the country to the south-east at Croydon King, and to the east-south-east about sixteen miles at Stanhills, is not suggestive of the rock being an intrusive mass in the finer-grained granites. It would be more reasonable to suppose that the coarse and fine granites are simply alternating masses or belts, and belong to the same general series.

The presence of the graphite in the granite has produced lines of weakness in the country in which it occurs, and very probably the action of the graphite in reducing friction, and in allowing lateral rock movements to take place with comparative ease, has been the primary cause of the flat angle of inclination which the Golden Gate Reef possesses. In the felsite country, where the graphite is only in minute quantities, the reefs are nearly vertical, and show an absence of the complicated movements which form so prominent a feature in the graphite-bearing granites at Golden Gate.

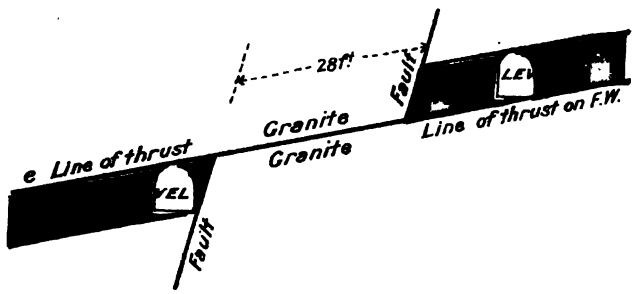
The coarse-grained granites occur in several places on the field, but at the No. 1-and-2 South Golden Gate the granite is identical with that occurring at the mine known as the "Rip and Tear," between Croydon and Golden Gate, where the rock is generally considered to be a type of intrusive granite. At the No. 1-and-2 Golden Gate, there is no appearance of this rock being intrusive, and it gradually merges into another, in which the mineral constituents are finer grained. The rock contains felspar (partly kaolinsed), quartz (very free from inclusions), and altered biotite mica. Portions of the altered rock show a cryptocrystalline deposit of silica as an accessory constituent.

The normal variety of granite on the field is a medium-grained rock, and that found at Plant's shaft may be taken as a type. In every respect, however, its mineral constituents are similar to the coarse-grained variety at No. 1-and-2 South Golden Gate.

Fine-grained granite is found in various parts of the field, but occurs noticeably on the north end of the line of reef. It is closely

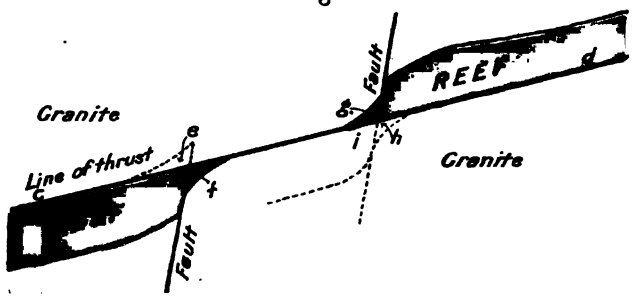
Fault Sections
in
Golden Gate 4 & 5 S. Block ('98)

Fig. 1



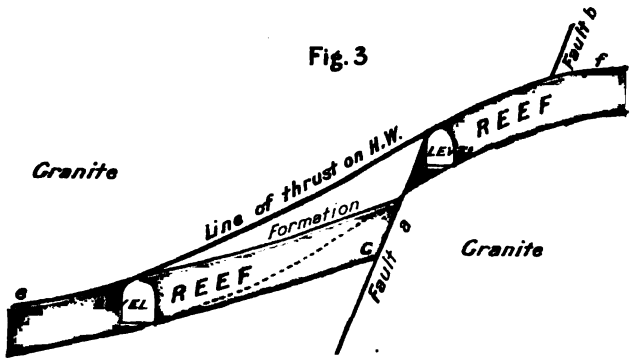
Section in Winze between 2 & 3 N. Levels

Fig. 2



Section in Winze between 1 & 2 S. Levels

Fig. 3



Section in Underlie Shaft
(near No 2 Level)

(Illustrating Report on "Some Croydon Gold Mines")

associated with a fine-grained binary granite, in which hornblende and mica are very rare. This latter type of rock, with another of much coarser texture, but of similar composition, also occurs in the zone of disturbance between the granite and felsite country.

Intrusive Rocks.

Dykes of (?) dolorite occur in several of the mines along the Golden Gate Reef, and during the plotting of dykes on a general plan subsequent to the examination of the underground workings, it was found that they extend all along the line of reef, and are nearly all connected with one another. (This is shown on the general plan, No. 1, and with greater detail on Plan 2, Sheet 2.)

The rock is much decomposed, and no specimens were obtained sufficiently fresh for purposes of determination. Amongst the miners the dykes are known as "clay heads," but much confusion exists regarding their origin, as it is not clearly understood that all "clay head" have not been intrusive rocks. In some of the mines the clay has been filled into joints from above, and is not the decomposition product of a dyke rock, *in situ*; on the other hand, many "clay heads" are unquestionably dykes which are more or less decomposed.

The dykes vary from a few inches to several feet in thickness; one near Ryan's No. 12 South is said to be twenty feet from wall to wall, while others exist not more than two inches thick. On several of the accompanying plans and plates, vertical sections are given of the dykes associated with the reefs where mining operations have exposed them, and other plans show their general trend and position.

It has been considered that the presence of the dykes influences the gold-bearing quality of the reefs with which they are in contact, and some miners are of the opinion that the effect is to make a reef rich on one side of a dyke and poor on the other. The dykes, however, cannot have any possible bearing on the occurrence of the gold, as they were intruded after the reefs were formed. Illustrations of this will be seen in some of the sections in the accompanying plans and plates.

Plans 1 and 2 show the general trend of the dykes on the surface throughout the field. Plan 8 shows the dyke intrusion in Roger's No. 1, west of the 120-ft. vertical shaft, and Plan No. 9 illustrates a section of the same dyke in No. 6 shaft, and also a section of what is probably a fault in the 120-ft. shaft (in the Golden Gate United) east of the No. 1-and-2 South lease.

The dyke in the disturbed portion of the reef in Viles' underlie is represented on Plan 11. On Plan 12, the dyke in the underlie of No. 9 South is shown in section, also the "clay head," or decomposed dyke, in the workings on the Nancy Lee Reef in No. 9 South Block.

On Plan 13, a section is given of the No. 11 South, where probably a dyke exists to the east of the bottom of the underlie shaft. Plan 14 shows the large dyke at No. 12 South, where the reef is faulted to the west.

On Plate 1 a diagrammatic section of the dyke in the Golden Gate No. 4-and-5 South Block is shown, illustrating the alteration of position by subsequent faulting. Plate 2 shows the dyke in association with faults and overlaps in the workings of No. 5 South, and of the No. 4-and-5 South Block.

Fig. 1, on Plate 5, represents a section in the No. 5 South, where a dyke has been intruded subsequent to the formation of the reef, while Fig. 2 shows a dyke intrusion along a fault plane in Viles' underlie. Plate 10 represents a section in No. 12 South, and illustrates the dyke traversing the fault in that locality.

Fig. 2, page 21, shows a dyke mass disturbed by a subsequent fault in the Golden Gate United, and in Fig. 4, page 27, a section in the same mine shows the irregular character of the dyke in the granite above the reef.

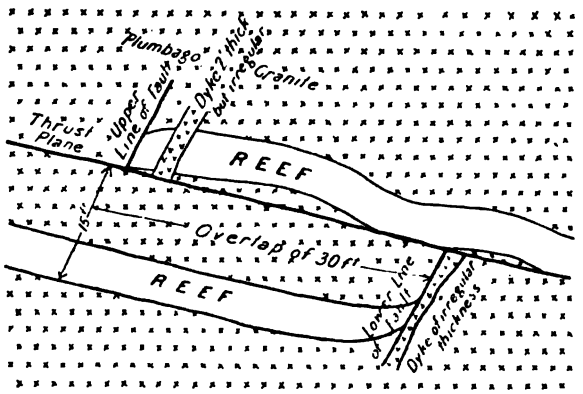
Faults.

Faults in the Golden Gate Reef are of common occurrence, and their presence in some of the mines has caused considerable trouble in the methodical working out of the bodies of rich stone which they have disturbed. They have a general north-and-south trend, although varying considerably from this direction, and have a dip, usually nearly vertical, but occasionally parallel with the dip of the reef. In the former case the reef is dislocated by a downthrow, either to the east or to the west, generally the latter when the dislocations are severe and infrequent, and the former when the faults are small but numerous. The faulting along the dip of the reef is not always perceptible, being produced either by the sliding of the hanging-wall over the top of the reef, or by the sliding of the reef along the footwall. The slickensides on the walls, however, are unmistakable proofs of the faulting having taken place. Where the dip fault crosses a vertical fault the behaviour of the two faults is clearly seen.

The dip faults are nearly all thrust faults, and, in some places, cause the reef to separate at right angles to a vertical joint, and thus leave blank portions between the walls; while in other parts parallel with the blank portion of the reef where broken, the thrust faulting produces an overlap; in fact, the operation of thrust faulting, which produces the blank in one part of the reef, also produces the overlap in another portion. Examples of this are shown in the accompanying plans. Plan 8 shows the fault in Rogers' No. 1 (Golden Gate, Limited), and Plan No. 9 the faults in Rogers' No. 1, and No. 1-and-2 South.

Plan 11 shows other faults in No. 9 South; while on Plan 14 a diagrammatic section is given of a fault in the Golden Gate and Nancy Lee Consols (Drawbridge's).

Fig. 1.



SECTION IN ROGERS' No. 1.
(Showing an Over-thrust where the Reef has been Faulted).

Plate 1 shows a section illustrating the successive movements in the faulting of the Gate Reef, at a position west of the vertical shaft in the Golden Gate 4-and-5 South Block, and close to the boundary of the 3-and-4 South. On Plate 2 is represented some fault sections in Golden Gate 4-and-5 South Block ("98"), and Plate 4 shows a section of portion of the workings in No. 5 South and No. 4-and-5 South Block, and illustrates the faults and dykes, and the overlapping of the reef. Plate 5 shows fault sections in No. 5 South and Viles' Block, and on Plate No. 6 there are diagrams illustrating features in the Golden Gate and Nancy Lee Reefs. On Plate 7 a diagrammatic section is shown of the faults in the Golden Gate Reef in the No. 9 underlie, and Fig. 2, Plate 9, represents a section showing the fault (or "break") at the No. 12 South (Ryan's). Plate 10 represents a section along the No. 12 South fault, and shows the position of the fault where it dislocates the reef at this locality. Plate 11 shows a general section at the 18 South Banner, and the disturbance of the reef by a severe fault.

Text Fig. 1, on this page, is a section taken from Rogers' No. 1, illustrating the over-thrust of the reef at a fault. Fig. 2, page 21, and Fig. 3, page 23, are sections of an over-thrust in the Golden Gate United.

SEDIMENTARY ROCKS.

The Sedimentary Rocks around Croydon comprise sandstones, conglomerates, and ironstone cements, and form two distinct, although probably conformable series. The older series consist of fine-grained

horizontally-bedded sandstones and conglomerates, containing numerous marine fossil remains belonging to the "Desert Sandstone" (Upper Cretaceous) Formation. The younger series, probably of Teritary Age, comprise deposits of ferruginous cements, sandstones, and conglomerates, which form the flat country extending away to the west of Croydon, and which show evidence of being more recent than the Desert Sandstone Formation. This evidence consists in the exposure of the younger series resting on escarpments of fossil-bearing Desert Sandstone to the north and south of Croydon.

From an economic point of view the two series are of no importance, although in the younger formation a small band of coal occurs near True Blue, between Croydon and Golden Gate. This coal is the variety known as lignite, but it is of inferior quality and quite useless.

At Golden Gate these sedimentary deposits had to be pentrated in some of the shafts before the cap of the reef was met with, and in places the reef has only been found after sinking twenty feet through ferruginous conglomerates and sandstones.

The outcrop of the Gate Reef occurs in very flat country, and the accumulations of these younger deposits have quite obliterated all traces of the reef in many places on the surface. If the deposits had been a few feet thicker or were a few feet higher, the whole line of outcrop of the Golden Gate Reef would have been completely covered, under which circumstances it is very probable that the line of reef would have remained undiscovered at the present day. It shows the possibilities of other reefs existing in the Croydon district, whose outcrops have been submerged by the accumulation of sedimentary deposits over them.

Deposits of recent alluvium have been formed around Golden Gate as a result of the disintegration of the hilly felsite country, but they are confined to the banks and beds of the present watercourses, and are very limited in extent. In places they have been proved to be gold-bearing, but away from the outcrops of the reef they are quite barren.

The history and general geological features of the Croydon Goldfield, as a whole, are given in detail in the report by Mr. W. H. Rands, previously referred to, and as the report is not out of print, no further reference will be made to that portion of the subject.

THE GOLDEN GATE.

The general strike of the Golden Gate Reef is about north-north-west and south-south-east, and the dip is about east-north-east, at an angle from the horizontal of about 1 in 3 (18°). The direction of strike varies in different localities, while the dip has considerable variation from the above angle, being sometimes as flat as 1 in 4, or as steep as 1 in 2. The details of the various dips are shown on the accompanying plans and plates.

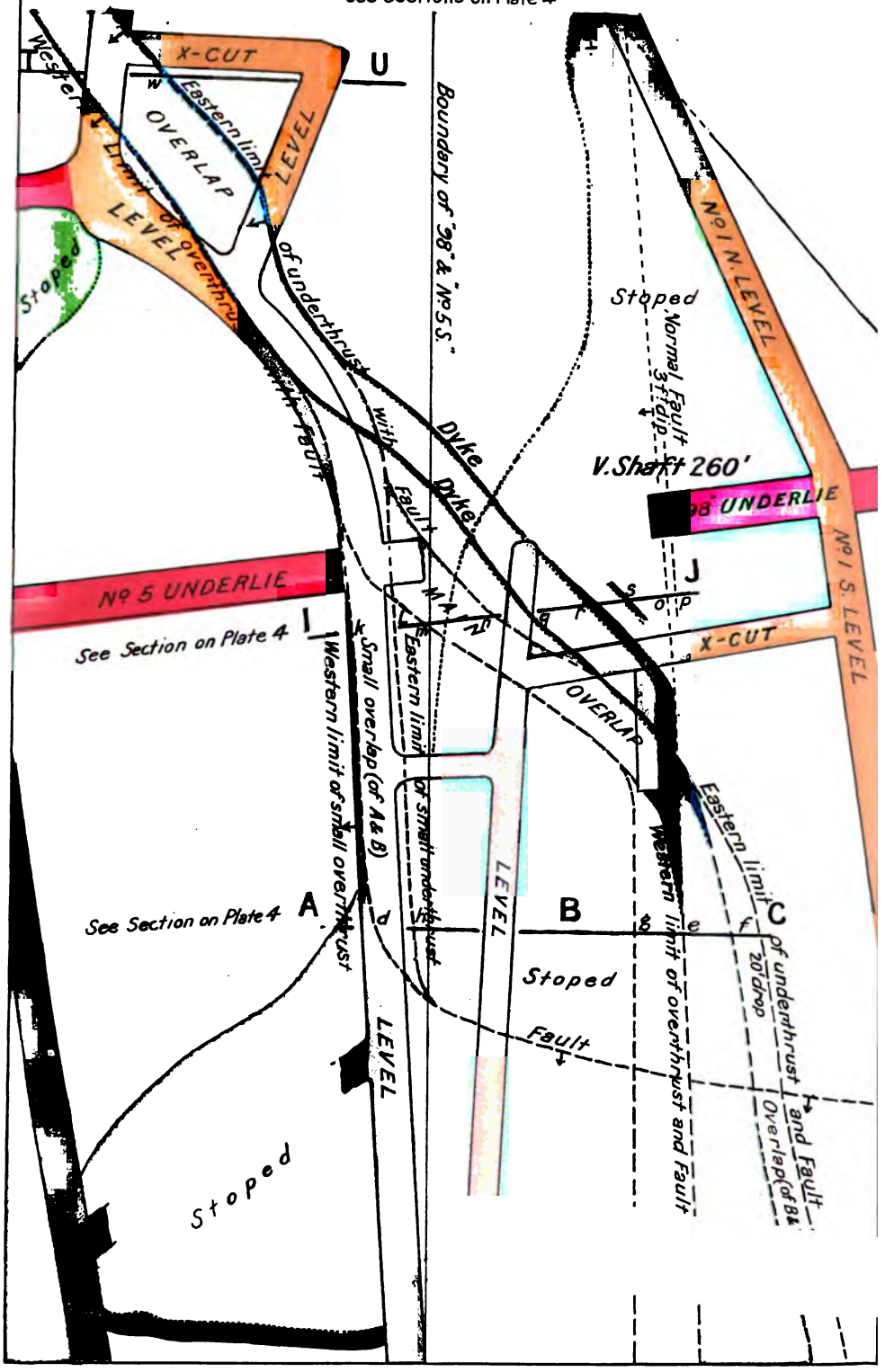
Plan of Portions of No 5S. & No 4 & 5S. Block

showing Faults, Dykes & Reef overlaps

Scale 25 feet to an Inch

25 20 15 10 5 0 25

see Sections on Plate 4



(Illustrating Report on "Some Croydon Gold Mines")

The thickness of the reef varies from a couple of feet to perhaps over thirty feet, but five or six feet may be considered the average size. The reef usually carries a class of stone which is not gold-bearing, and is known as "buck," although some stone in the reef which is not "buck" also is not gold-bearing. From the evidence which has been obtained these classes of stone—"gold stone," "poor stone," and "buck"—have been formed at two distinct periods. (*See* Plate 6, Fig. 3.) The characters of each are difficult to distinguish, and still more difficult to describe, but in general appearance they all are more or less iron-stained and frequently carry pyrites. The gold-bearing stone in addition carries galena and zinc-blende, and is not so glassy in appearance as the "buck." The portion of the reef which is not "buck," but which is not gold-bearing, is characterised by the absence of galena, this latter mineral being a persistent associate of the gold in the Golden Gate Reef. The galena occurs in extremely fine particles, and where the gold is richest the particles of mineral are so finely disseminated that it gives to the quartz a dark-leaden colour.

Between the walls of the reef a "formation," composed of fragments of country rock, frequently occurs mixed irregularly with the quartz. Sometimes it separates the "buck" from the gold-bearing stone, and as frequently forms a mass on the hanging and foot walls, or else it occurs as bands alternating with "buck" or gold-bearing stone. Occasionally it occupies the whole of the space between the walls, with the exception, perhaps, of a thin seam of quartz on either the top or bottom.

In the Rogers' Extended Block shaft the reef in one place is composed of calcite, this mineral having been found to gradually displace the quartz as the prospecting operations extended into the deeper ground. The calcite crystals found in cavities in this part of the reef have a mineralogical habit not previously recognised, and have been illustrated in the Records, No. 2.*

The rich and poor parts of the Golden Gate Reef have, of course, been a subject for consideration and much discussion on the part of those interested in the development of the mines, and many wild theories have been advanced to account for the presence of the gold. Mining operations have revealed the character of the rich ore bodies, and the recent geological survey carried out has enabled their positions to be fixed and their underground features correlated. The results show that shoots of gold-bearing stone can be distinguished, having a north-easterly dip, but this general feature cannot be relied on as a safe guide in opening up a mine far away from where good stone has been obtained in the same reef.

The accompanying large plan (Map 2, in four sheets), on a scale of 100 feet to the inch, will show, in colour, the country which

* Queensland Geological Survey. Records, No. 2. By B. D. Bris.: By Auth.: 1905. Page 25, plate 5. (G.S.Q.P., No. 196.)

has been prospected, and that which has been worked out. From this plan, it will be observed, the occurrence of the gold in the reef is by no means uniformly along shoots having a general direction of dip.

One noticeable feature concerning the rich parts of the reef, however, is the presence of rich stone where the reef is faulted, or where it takes a sharp fold with a northerly dip, the effect of which has been to throw down the reef on the north side and cause the outcrop of the reef on that side to extend further west of the outcrop on the south side. Where this takes place the reef has been found to be rich on the north side of the fault or fold. To bring about this result a lateral (northerly) movement of the hanging-wall, after faulting, has probably taken place to produce fissures which have been filled with gold-bearing quartz. With a fault dipping to the south, the reef on the south side would be thrown further west than on the north side, and instead of opening a fissure in which the gold-bearing stone would form, the effect, with the same lateral (northerly) thrust, would tend to compress the country rather than open it, so that the accumulation of gold-bearing stone would not take place to the same extent.

The outcrop of the Golden Gate Reef has been clearly defined where most of the mines are situated, but from the evidence of miners, it apparently extends beyond the Golden Gate township for several miles in a north-north-westerly direction, although the absence of payable stone on the surface has not encouraged further prospecting work to be carried out on it.

To the south-south-east of the township, the reef has a branch called the Nancy Lee Reef, but the main reef continues to the railway bridge on Belmore Creek, about one and a-half miles from Golden Gate Railway Station. (*See* Plan 1.) The reef was not examined south of this bridge, but it outcrops further on in this direction, where it is known as the Sunset Reef. Here it is lost against an east-and-west fault, but surface and other features show a possible connection with the Content Reef much further east. The fault in this case produces a downthrow on the north end of the Content, and throws the outcrop on that side west to the Sunset.

The Nancy Lee Reef trends away from the Golden Gate Reef in a south-easterly direction (*see* Plan 1), and has a north-easterly dip at an angle varying from 1 in 2 to 1 in $1\frac{1}{2}$.

Where developments have taken place in the deep ground beyond the line of junction of the two reefs, some difficulty has been experienced, where two reefs have been found, in deciding which is the Golden Gate Reef and which the Nancy Lee. It has been supposed that the Nancy Lee Reef in being steeper than the Golden Gate Reef has crossed the latter, and that a reef found in Plant's shaft in the deep ground at a depth of 804 feet is the Golden Gate Reef, while the lower reef at

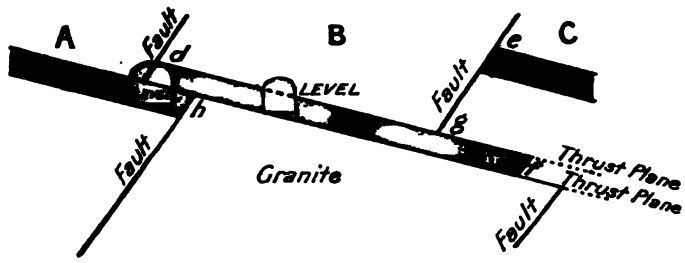
Sections of Portion of Workings on Nº5S.& Nº4&5S. Block

Showing overlaps of Reef, faults & Dykes

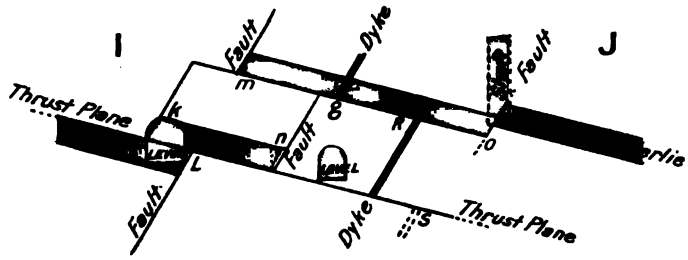
Scale 25 feet to an Inch

25 20 15 10 5 0 25

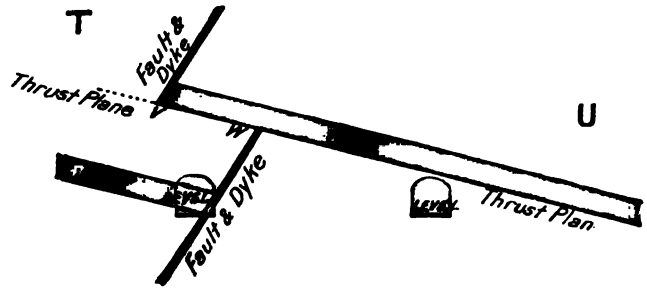
Section on Line A.B.C (Plate 3)



Section on Line I.J (Plate 3)



Section on Line T.U (Plate 3)



(Illustrating Report on "Some Croydon Gold Mines")

925 feet must be the Nancy Lee Reef. On the other hand the Nancy Lee Reef has not been observed to pass through the Golden Gate Reef where it has been exposed in ground nearer the outcrop.

Sections of the two reefs are shown in several of the accompanying plans. Plan 13 shows a diagrammatic section of the country through the Nancy Lee Consols shaft, from the outcrop of the Golden Gate Reef to Plant's shaft, and indicates the possible relation of the two reefs to one another. Other sections of the two reefs are shown on Plans 12 and 14, and on Plate 6, Fig. 1, and on Plate 12. Further reference to this portion of the subject will be referred to on page 30, in describing the operations at Plant's shaft.

MINES AT THE NORTH END OF THE GOLDEN GATE LINE OF REEF.

At the northern end of the line of reef, at varying distances from Golden Gate Creek (*see* Plan 1), a number of prospecting shafts have been sunk for the purpose of finding a continuation of the reef which to the south has proved so productive. Many of the shafts have been successful in discovering a reef or formation, but without finding payable gold-bearing stone further north than the mine known as No. 10-and-11 West.

A very large "formation" having well-defined walls is present at this end of the field, and is associated with a barren quartz reef and with leaders.

It will be seen on reference to Plan 1 that the felsite in contact with the granite takes a sharp turn on this part of the field, and is close to the line of outcrop of the reef. Possibly the mass of felsite has here produced compression in the granite, and, to a great extent, has prevented the formation of a fissure, and that in consequence the reef has much diminished in size or pinched out altogether. The positions of the shafts are shown on Plan 1, and also on Plan 2, on a scale of 100 feet to one inch.

No. 10 NORTH, No. 10-AND-11 WEST, AND No. 9 NORTH.

No. 10 North, No. 10-and-11 West, and No. 9 North are the mines at the northern end of the field where the reef has been proved to be gold-bearing. Mining operations here have been conducted on a large scale, and the accompanying Plans (2, 3, and 4), show the underground workings on a scale of 100 feet to one inch.

A specially interesting feature in this part of the Golden Gate reef is the marked change in the direction of dip from the normal north-north-east to one more nearly north, and the rich yields of gold from the reef where this irregularity in the reef takes place. Another feature is the convergence of a number of curved lines and faults met

with in the eastern workings of No. 10 North, an effect evidently resulting from the unequal pressure exerted by the mass of felsite previously referred to, and which must be close to the end of the underlie sunk from the 111-ft. vertical shaft in the ground of the No. 10 North.

On Plan 2 is shown the position of the granite and felsite in relation to these mines, and also the reef in the mines known as No. 8 North, No. 9 North, and No. 10 North. The effect produced by the irregularity in the line of contact of the granite and felsite is, in part, to compress the granite opposite two folds of felsite, and to prevent the formation there of fissures. This would result in the formation of reefs of diminutive size, and would account for the small thin vein in the mines referred to above, where the workings have advanced close to these felsite protuberances: while the country between the folds would be sufficiently released from pressure to allow of large fissures being opened, and which subsequently would be filled with quartz. In No. 10 North (*see* Plan 2, Sheet 1) the reef becomes well-defined as the distance from the felsite increases, and in No. 9 North the country would be favourable for the formation of a thick reef where the depression exits between the folds—that is, about north of the 145-ft. vertical shaft, and near the bed of the Golden Gate Creek.

In No. 10 North the granite to the south-west of the felsite fold must be very much compressed, and the probability of finding there anything but small veins of quartz is very remote. The workings further east on No. 10 North (*see* Plan 3) indicate that a large amount of exploratory work has been undertaken for the purpose of finding a continuation of the rich stone met with nearer the outcrop. The severe roll, or fall-over, on which the winze (marked L on Plan 3) has been sunk, trends easterly and gradually dies out, a joint or fault having a south-easterly strike only now being visible. It would not be possible to follow this fault line with any certainty of picking up the reef again, as its junction with other faults in the vicinity would undoubtedly cause confusion, the best course being to drive northerly, as mentioned above, from the present workings in No. 9 North.

The country east of the granite-felsite boundary does not offer any encouragement for prospecting, and the only hope of finding a gold-bearing reef there is to sink through the felsite into the granite which underlies it, and pick up the Golden Gate reef in the deep ground.

No 8 NORTH GOLDEN GATE (LEASE 637) CROYDON CONSOLS.

There are very extensive underground workings in this lease, and a very large yield of gold has been obtained from the reef in the western portion of the ground. The felsitic rocks occurring in the lower (eastern) workings are not of the pronounced type as those

further north-west, and are more basic in composition. Where they are in contact with the granite a disturbance has taken place, and in this disturbed zone the mining developments which have been carried on have not been successful in obtaining gold-bearing stone sufficiently rich to pay working expenses. It must be noted, however, that the felsite here differs very much in its mineralogical characters from the felsite which has been met with in the Golden Gate Consols adjoining lease, where the reef has proved very productive in the deep ground. After an examination of the underground workings, no special feature could be pointed out to encourage further development, either by sinking the 365-ft. (No. 3) Block shaft to a greater depth or by extending the underlie from it.

On Plan 2 the position of the underground workings on the mines of the Croydon Consols are shown, and on Plan 5 a vertical section illustrates the workings from west to east, on a scale of 100 feet to an inch.

No. 7 NORTH, No. 5-AND-6 NORTH, AND DOUGLAS BLOCK SHAFT.

Most of the gold-bearing stone in No. 7 North was worked out many years ago, and very little of the reef now remains which has not been prospected either by underlie or by levels. In the lower levels the reef is of very small size, and where prospecting operations have been discontinued in the deeper workings near the eastern boundary, the reef is only a couple of inches thick, which, however, is gold-bearing. From observations made in the adjoining mine to the north (No. 8 North) it would appear that the reef exposed in the bottom workings of this mine is not the only one in existence; but, as the others must be very small and the country they occur in very hard, it would be impracticable to prospect further. It also is apparent that the reef worked in the north-east corner of No. 7 North corresponds to the footwall and not the hanging-wall leaders met with in the underlie workings of No. 8 North.

The thinning-out of the reef on the eastern boundary of No. 7 North probably extends easterly and south-easterly into the Golden Gate Consols ground (Lease 687), and to the country which would be worked to the dip from the Douglas Block shaft.

To the south-west of the Douglas Block shaft, and between the workings of the No. 5-and-6 North, and those of the Golden Gate Consols northern underlie, there is a large area of unprospected country. Tracey's underlie has passed through a large belt of barren reef, and the prospecting work in the Douglas Block shaft has failed to find gold-bearing stone. The reef, therefore, between Tracey's underlie and this Block shaft does not present any sufficiently favourable feature to warrant any further development on it in this direction.

In the underlie from the 87-ft. vertical shaft, near the centre of the No. 5-and-6 North, payable stone has been met with, and possibly a continuation of this shaft in depth might reveals the occurrence of stone in the north-western portion of the large area between the workings of the No. 5-and-6 North, the Golden Gate Consols northern underlie and the Douglas Block shaft.

In making a plan of the underground workings in the No. 7 North, it was noticed that several faults or breaks trend in a northerly direction, and, on further examination, their continuation was traced into the workings of the No. 5-and-6 North. They form a number of parallel lines in plan, but in section their angles of inclination are not uniform. Their direction is persistently northerly, but as they trend from the workings in this direction, very probably they will be found to bend around to the north-west to conform with the general strike of the reef and the disturbances in No. 8 North.

On Plan 2 is shown the portion of the underground workings in the No. 7 North, No. 5-and-6 North, and Douglas Block shaft; and Plan 6 shows the same workings in vertical section.

GOLDEN GATE CONSOLS.

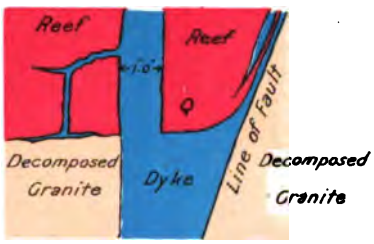
The workings on this mine consist of an underlie shaft, which has been sunk almost from the outcrop of the reef to the deep ground on the eastern boundary, and a second underlie from the bottom of the 226-ft. vertical shaft which continues along the course of the reef into the deep ground close to the eastern boundary. The two underlies are connected by levels, and the work of developing the rich ore reserves around the bottom of the second (southern) underlie is now being carried out.

The country in which the reef exists in the deep ground is not uniformly the coarse-grained mica granite found nearer the outcrop further west, but is made up of this rock with coarse and fine-grained binary granite having included masses of felsite.

The character of the rocks in the bottom levels suggests that the country to be met with on the other side of the boundary, in Lease 876, will be similar to that found in the deep levels of No. 7 North (Croydon Consols), where binary granite and felsite merges into a quartz-felsite. The latter rock has not been found in the Golden Gate Consols Mine, but the positions at which this rock has been observed may be seen on referring to Plan 2, on which also is shown the approximate surface line of contact between the granitic and felsitic country. The junction of the granite with quartz-felsite and binary granite along this line of contact, it will also be observed, extends further north-west into No. 8 North, and the angle of inclination in this mine

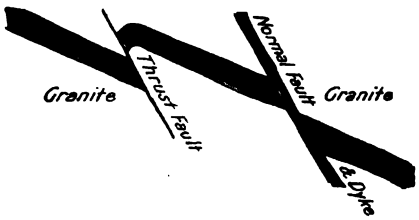
Sections in Nº 5 South Viles' Block & Nº 8 South Block

Fig. 1



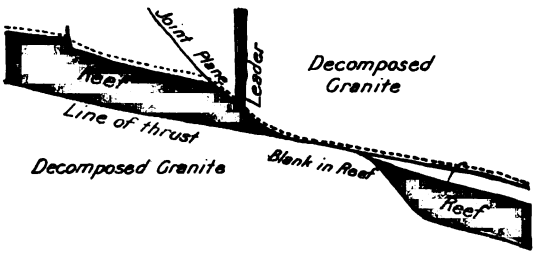
Dyke intrusion in 17 N. Level. Nº 5 South
Showing the Dyke intrusion in the Reef and along the Fault

Fig. 2



Section in Viles' Block Underlie Shaft
Showing dislocations in the Reef

Fig. 3

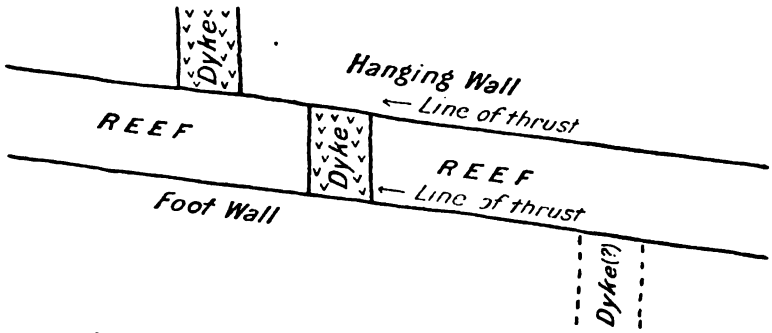


Section in Winze above Nº 1 South Level in Nº 5 South Mine

(Illustrating Report on "Some Croydon Gold Mines")

(*see* Plan 5) if continued in the ground of the Golden Gate Consols, would indicate the granite to probably underlie the felsite at an angle of over 40° from the horizontal.

Fig. 2.



SECTION ON NO. 2 NORTH LEVEL, GOLDEN GATE UNITED MINE.
(*Showing the disturbance of a Dyke by Faults along the hanging and foot walls.*)

At the depth of the workings in the Golden Gate Consols, the felsite (with the above angle of inclination from the surface) would be a considerable distance away from the eastern boundary of Lease 687, so that no anxiety need be felt that the unfavourable condition met with in that mine will be repeated here. At the same time, in the No. 8 North the change from favourable to unfavourable conditions is remarkably sudden, and it would be advisable to study the deep workings in this mine with a view of applying the information obtained to the developments proceeding in similarly deep ground in the Golden Gate Consols.

A section of the underground workings of the Golden Gate Consols is given in vertical sections on Plan 7, which also shows the approximate position of the line of contact between the granitic and felsitic rocks. An examination of this section and that of the underlie workings in the No. 8 North, together with the plan of the same workings (*see* Plan 2), indicates the probability of the reef splitting up into a number of small veins, and that in consequence, in prospecting one of them, others might be passed over or neglected, which possibly would be equally, if not more, important from a gold-bearing point of view.

It might also be added that the occurrence of leaders in various parts of the deep workings here is only a repetition of what has been experienced in the Croydon Consols Mine, and attention to the peculiarities noticed in that mine, as stated before, might be of great advantage in elucidating local features as they became exposed.

GOLDEN GATE LIMITED (ROGERS' No. 1).

The western workings in the Golden Gate, Limited, begin at a shallow shaft (No. 1 shaft) close to the outcrop near the western edge of the lease. This portion of the ground was worked many years ago,

and, as most of the underground workings could not be examined during the recent inspection, an old survey plan in existence has been utilised to show their position.

To the west of No. 2 shaft (*see* Plan 2, Sheet 2), the mining developments have disclosed a disturbance in the reef, and this proves to be a fault in combination with an overlap. A section of this is shown on Plan 8, while an enlarged section is represented in Fig. 1, page 13. The overlap probably extends further north, along the strike of the reef, but nothing has been seen of it in the workings of the Golden Gate Consols, and it probably pinches out in the country between the two mines. In a southerly direction the disturbance is evidently persistent in its occurrence, a dyke and fault having been passed through in No. 6 shaft, and quite probably the overlap referred to above also exists here.

From the No. 2 vertical shaft an underlie has been sunk in an easterly direction, and from this a prospecting level has been driven to the north, in which mineral has been found in both the reef and the altered granite walls, but the presence of gold has not been detected.

From No. 3 (Block) shaft three underlies have been sunk. In the old (eastern) underlie the stone was too poor for working, but the dip of the reef, instead of being east-north-east, was found to bear more to the north, and necessitated the sinking of another underlie from the same shaft before further exploratory work could be undertaken. Later on, new features developed, and the third underlie was sunk, the second one in its turn being abandoned. It will be seen on Plan 2, Sheet 2, that the stone to the east and also to the east-north-east and east-south-east has not been touched, while that north from No. 2 has been completely worked out. The payable stone here is entirely on the western side of the present working underlie, and the shoot of stone passes into the Golden Gate Consols Mine adjoining, where it now is being worked.

The Extended Block shaft (No. 4) has been put down to develop the Gate Reef in Lease 732, but up to the present has not succeeded in finding stone sufficiently rich to pay for the necessarily heavy working expenses. Evidently the shaft is in a poor zone, whose outcrop is principally in the ground of the No. 1-and-2 Golden Gate, and whose boundary touches the workings of the Golden Gate, Limited, to the north-west, and the workings of the Golden Gate United to the south-east. In this generally poor zone, however, the indications show that gold-bearing stone occurs in small, rich patches, but very irregular in ocurrence.

The change from granitic to felsitic rocks, easterly from the Extended shaft, takes place some distance away on the surface, and as the line of junction between these two series of rocks has an easterly dip, the granite must extend to a distance greater than 1,000 feet easterly from the bottom of the Extended Block shaft. If a shoot

Diagrams & Sections

Illustrating features in the G.Gate & Nancy Lee Reefs

Fig. 1

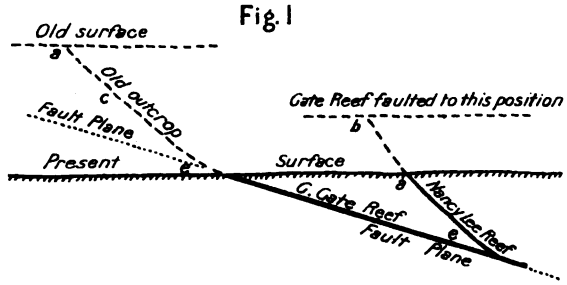
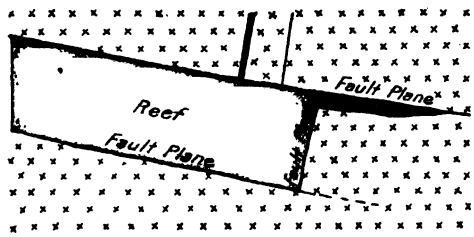


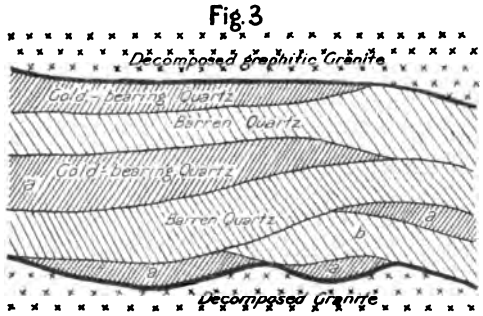
Diagram illustrating the possibility of the Nancy Lee Reef being a portion of the Gate Reef faulted from a higher level

Fig. 2



Section in P.C.Underlie, Nancy Lee Reef showing the effect of faulting

Fig. 3

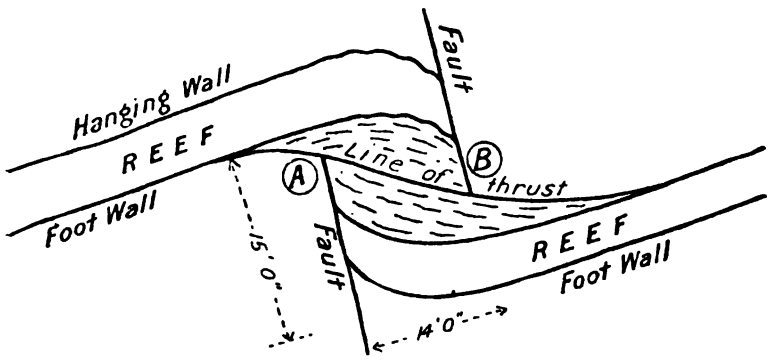


Section of Gate Reef at Nº 8 South Block Mine showing the alternations of Gold-bearing and barren Quartz

(Illustrating Report on "Some Croydon Gold Mines")

of ore were to be found in Morgan's Block shaft, or in the Golden Gate United Company's ground, it would be quite reasonable to suppose, bearing in mind the general trend of the rich shoots in the reef, that rich stone would be found under the felsitic rocks which outcrop on the surface near the south-east corner of Lease 732. Details of the workings of the Golden Gate, Limited, are shown on Plans 2 (Sheet 2), 8, and 9, the latter two illustrating vertical sections of various portions of the underground workings.

Fig. 3.



DIAGRAMMATIC SECTION OF PEAK IN THE NO. 3 SOUTH LEVEL, GOLDEN GATE UNITED MINE.
(Showing the faulting, and the subsequent overlap.)

No. 1-AND-2 SOUTH GOLDEN GATE. LEASE 967.

The workings on this lease have been of a general exploratory character, but, up to the present, very little gold has been obtained from the reefs, leaders, and formations which have been proved to exist on it. On the northern end of the lease the work done in Wates' shaft shows that there are three "formations," quite distinct from one another, and the difficulty experienced has been in determining which one belongs to the Golden Gate Reef. From the evidence obtained in this shaft, and others further south, it would appear that the country has been disturbed in more than one place, and that the fissures resulting from this disturbance have been filled simultaneously with either quartz or "formation."

Plan 2 (Sheet 2), shows the position of the various shafts, together with the probable lines of outcrop of three reefs, and on Plan 9 there are shown vertical sections across the shafts known respectively as Anderson's, Carroll's and Wates'. The section across Anderson's and Carroll's shafts on Plan 9 shows the outcrops of three reefs and the probable blending of two to form one reef, only two reefs occurring further south.

Reference has been made previously, in describing the workings in Rogers' No. 1, on the occurrence of a poor zone in this part of the Golden Gate Reef, in which small, rich, and very irregular bodies of stone might be found.

GOLDEN GATE UNITED.

On this mine the 173-ft. vertical shaft has been sunk in a fault extending from the No. 3-and-4 and the No. 5 Leases further south, and which evidently continues northward towards Rogers' No. 1. The underlie from the vertical shaft has been sunk for a considerable distance, and about one-third of it has passed through payable gold-bearing stone. In the first 200 feet the reef has proved to be barren, and for about the same distance at the bottom of the workings the same class of stone has been met with. About the central portion of the underlie an area of good stone has been worked out.

Dykes and faults have proved troublesome, and an overlapping of the reef exposed in No. 3 South level was the cause of much dead work being undertaken before this feature in the reef was understood. The portions of the reef which have been proved to be gold-bearing are of limited extent, and are shown on the general plan of the workings (Plan 2, Sheets 2 and 3), while on Plan 10 some peculiarities which have been observed on the structure of the reefs are illustrated in vertical section.

The gold-bearing stone in the reef is a continuation of the same shoot worked in the No. 3-and-4 Lease adjoining the United (to the south), but from its failure to discover good stone the level near the bottom of the underlie is evidently in poor country. The prospect of finding rich shoots of stone seems to depend more on the extension of the workings in the deep ground than upon the continuation of this bottom level.

Fig. 2, page 21, Fig. 3, page 23, and Fig. 4, page 27, show sections illustrating features in the Golden Gate United.

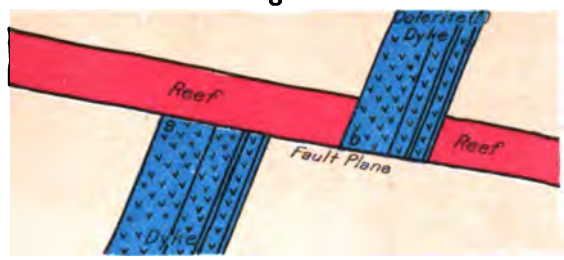
No. 3-AND-4 SOUTH.

This mine in past years produced a large quantity of gold, but the reef is nearly exhausted, and only the lower portions of the north-east corner remain untouched. The faulting and overlapping of the reef in the Golden Gate United Mine extends southerly through the No. 3-and-4, and have given rise to much trouble in exploratory work. The position of the workings in this lease is given on Plan 2, Sheet 3, and vertical sections are illustrated on Plan 10. The sections on the latter plan show the disturbances in the reef near the No. 3 (95-ft.) shaft, and at the bottom of the underlie shaft. The country above the reef has been thrust towards the west, producing a horizontal overlap in the reef in the deep ground, and at the same time forming a corresponding gap or blank in the reef further west at the bottom of the No. 3 shaft. This overlapping and the blank area is shown in Plan 2, Sheet 2, these features, it will be observed, extending both in a northerly and southerly direction.

Diagramatic Sections

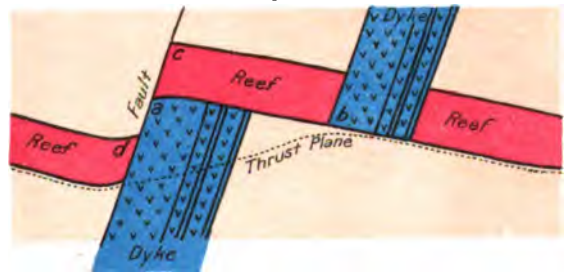
Illustrating the succession of faults in the Gate Reef in Nº 9 South Underlie

Fig. 1



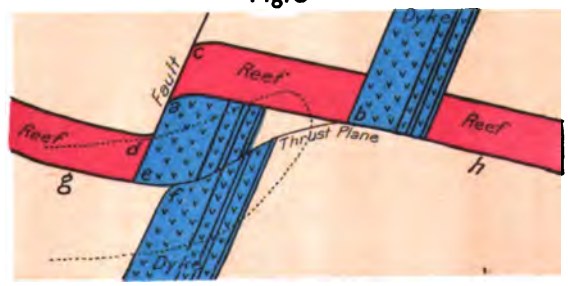
Dip Fault dislocating a Dyke along the footwall of Reef

Fig. 2



Normal faulting of the Reef along the hangingwall of the Dyke

Fig. 3



Thrust Fault disturbing the lower portion of the Dyke

(The part enclosed within the dotted line is exposed in the bottom of underlie)

(Illustrating Report on "Some Croydon Gold Mines")

No. 5 SOUTH, No. 4-AND-5 SOUTH BLOCK ("98"), MORGAN'S BLOCK SHAFT, AND THE GOLDEN GATE AND NANCY LEE UNITED (VILES').

The blank area near the surface, referred to previously, has been traced in a southerly direction from the No. 3-and-4 South across to the No. 5 South. A section of this break or fault is shown on Plate 5, Fig. 3, which, in addition, illustrates the normal faulting and the subsequent thrust faulting of the reef. From the blank area to the western side of the No. 5 Lease the reef has yielded rich stone, and the continuation of this shoot has also been worked in the adjoining No. 4-and-5 South Block.

The overlap in the No. 3-and-4 South Mine crosses the boundary of the No. 5, passes through the No. 4-and-5 South Block into the underlie of the Golden Gate and Nancy Lee United (Viles'). In the latter mine the fault has a drop of about eighteen feet, a section of which is shown in Plate 3, Fig. 3.

The movement in the hanging-wall country forming the blank area near the surface, and the overlap lower down the dip of the reef, has produced a second blank area in the reef further down the dip. A section of this is shown on Plan 11.

A plan and section of the workings in the No. 4-and-5 South ("98") are represented on a large scale on Plates 3 and 4, and on Plate 1 is illustrated a dyke intrustion which, by subsequent disturbance, has produced a rather complicated effect close to the bottom of the vertical shaft in this mine. The diagrammatic sections given on this plate show the successive movements in the faulting of the reef to be (1) the dyke intrusion, (2) the normal faulting of the dyke and reef, and (3) the faulting of the hanging-wall country along the thrust planes parallel with the reef. The position of the dyke (*see* Plate 1, Fig. 1) at x is above that at y, but the effect of faulting throws the portion x below that at y.

Some features are illustrated on Plate 2 bearing on the blank area in the No. 4-and-5 South Block. In Fig. 1 the reef is thrown a few feet along a previously existing joint plane, and the thrust movement along the *hanging-wall* of the reef at the lower level has been transferred to the *footwall* of the reef at the higher level. Fig. 2 shows a modification of the same effect: the fault has dropped the reef, and the thrust plane has been transferred from the hanging-wall to the footwall, the reef making a roll before faulting. Prior to the faulting, this monoclinal fold or roll has been produced in the reef at g and h. By the subsequent thrust the folded portions have been sheared, and while the portion g remains close to the fault, the portion h, being on the lower side of the thrust plane, has been detached from g, and transferred to f with the lower part of the reef.

Fig. 3 illustrates a further modification. The line of thrust has been confined to the hanging-wall, and the upper part of the fault

has been driven along the top of the reef to the portion *b*. In this case the reef is not separated horizontally, and no blank belt or area has been formed.

On Plate 5, Fig. 3, a section is given of the winze between the 20-ft. vertical shaft and No. 1 south level, in the No. 5 South Mine, illustrating the dislocation of the reef to form a blank belt between the hanging-wall and footwall. The section also indicates the position of the vertical leader joining the Golden Gate Reef in this part of the mine, and which is not connected with the Nancy Lee Reef in the vicinity.

Plan 10 shows the position of the workings at Morgan's Block shaft with regard to the underlie workings in the Golden Gate United, and also indicates, so far as the inclination of the reef is concerned, the relation of the workings of the No. 3-and-4 South, and those of the No. 4-and-5 South Block ("98") to be the same.

The deep ground in Morgan's Block and in the west portion of the "98" has not been prospected, but the richness of the reef along the frontage of the greater portion of this ground offers a very strong inducement for further prospecting operations. Even with the presence of a belt of country carrying poor stone, which is apparent between Morgan's Block and the shoot of rich stone in the Golden Gate United and the No. 3-and-4 South, it is reasonable to suppose that shoots similar in behaviour and character will exist at deeper levels.

Fig. 1, Plate 5, shows the relation of the dyke rock to the reef, the section indicating that the intrusion of dyke rock has taken place subsequent to the formation of the reef, and consequently would appear to have had no influence on the deposition of the gold.

The position of the workings in the Golden Gate and Nancy Lee United are shown on Plan 2, Sheet 3, and two vertical sections are given showing the underground features on Plan 11.

NANCY LEE REEF.

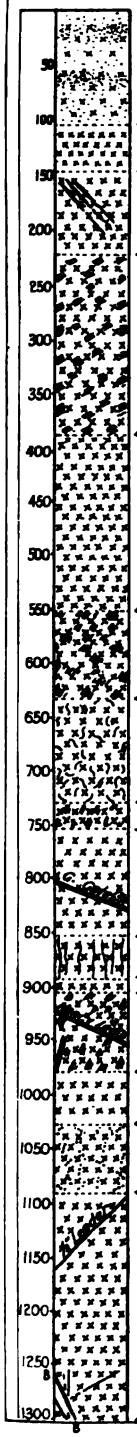
Close to the outcrop of the Golden Gate Reef, near the boundary of the No. 3-and-4 South, some confusion has been caused by the presence of a number of outcrops which evidently belong to reefs branching off from the main one. The surface workings of the No. 3-and-4 South have exposed a reef or "formation" associated with the Golden Gate Reef, but which, evidently, belongs to the Nancy Lee. Plan 2 (Sheets 2 and 3), shows the outcrop of the two reefs, together with their line of junction, and Plans 10 and 11 respectively illustrate vertical sections taken across No. 3-and-4 South and No. 5 South.

From the No. 5 South the outcrop of the Nancy Lee Reef evidently trends south-easterly, while the Golden Gate Reef trends further towards the south, and, consequently, the distance increases between

PLATE 8

Plant's Shaft (C.G. Gold Mines)

Section



Decomposed Granite (?) and Felsite, water at 108'

Fine-grained Binary-Granite

3" Quarry Leaders at 150'

Compact Granite (?) (Ferro-Magnesian mineral altered)

Compact Granite (?) with Graphite (Plumbago) inclusions. Quartz Leaders (8") with Calcite at 350 feet

Compact Syenitic Granite

Syenitic Granite with Graphite (Plumbago) and inclusions of bluish Graphitic Quartzite

Granite (?) with Ferro-Magnesian constituent altered to Serpentine

Granite (?) with Graphite

Granite

Golden Gate Reef (??) at 804 feet; 6 inches of Quartz; 1ft of Graphitic Granite in Hanging Wall

Granite (?) with vertical Leaders

Granite, 4 feet of soft "Formation" in Foot Wall

Syenitic Granite with inclusions of Graphite & bluish Graphitic Quartzite

Nancy Lee Reef (??) at 925 feet; 15 inches of Quartz: (Underlie sunk in this Reef)

Two Leaders at 950 feet

Syenitic Granite (without Graphite)

Altered Syenitic Granite, containing Galena, Fluorspar, Calcite & Pyrites

Graphite (Plumbago) Formation at 1090 feet, with Quartz Leaders. At 1095 feet Quartz Leader (½") dipping west at steep angle

Syenitic Granite; traces of Graphite; Quartzite inclusions; Hornblende (?) much altered

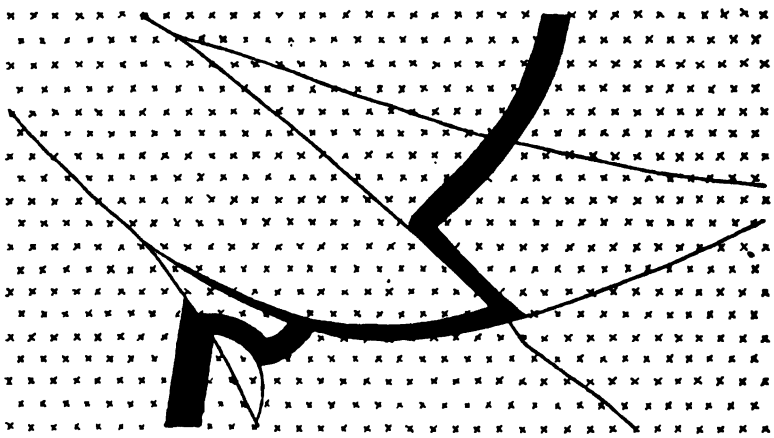
Leader in Shaft at B.B. probably "Butcher Boy"

(Illustrating Report on "Some Croydon Gold Mines")

the two outcrops, as the depth at which their junction takes place becomes greater. These features are illustrated on Plan 2, Sheet 3.

From No. 5 South the Nancy Lee continues into the No. 8 South (Baltic), where it has been worked in the Rose of Denmark shaft. This shaft was sunk many years ago, and the workings are inaccessible at the present time; but some of the miners who have worked in it state that four or five nearly vertical leaders exist close to the north side of the shaft, which have an approximately east and west strike, and are all gold-bearing. Evidently the leaders are not persistent in their occurrence, as a shallow hole to the west of the shaft failed to trace any indication of them. One of the leaders in the shaft passed out at the north side about thirty feet below the surface, but was found again in the underlie thirty feet from the vertical shaft.

Fig. 4.



SECTIONS 20 FEET BELOW NO. 2 NORTH LEVEL, GOLDEN GATE UNITED MINE.

(*Showing the irregular intrusion of the granite by a (?) dolerite dyke.*)

It is stated that at the bottom of the Rose of Denmark shaft the reef was followed down the underlie, and at the bottom it suddenly pinched out, and that in the north level a "formation" exists without a reef being present. Probably the pinching out at the bottom of the underlie is due to the fault which traverses the country to the east of the underlie, and if this be so, the reef which has been lost will be found in the hanging-wall country on the eastern side of the disturbance. In Viles' (Golden Gate and Nancy Lee United) underlie, the fault indicated a throw of about twenty feet, and this distance may be taken as a general guide for sinking were it thought advisable to prospect for the reef in the Rose of Denmark shaft.

South from the Rose of Denmark shaft, the Nancy Lee Reef has been worked in the leases now known as the No. 8 South Block, No.

9 South Block, and No. 10-and-11 South Block. In the No. 8 South Block the outcrop is close to the working shaft sunk on the Golden Gate Reef, and several shafts have exploited the Nancy Lee Reef. These mines could not be inspected, and the position of the underground workings, shown on Plan 2, Sheet 2, are only approximate. Plan 12 shows a section of the Rose of Denmark shaft, and also the relative positions of the Golden Gate and Nancy Lee Reefs.

In the No. 9 South Block the Nancy Lee Reef has been worked very extensively, and many thousands of tons of stone have been treated with very satisfactory results, but the workings have been abandoned for many years past. In No. 10-and-11 South Block the reef has been prospected by the P.C. underlie shaft and by two long levels from the underlie, a large area of ground being stoped out. Two cross leaders have been met with and are shown, with other features, on Plan 2, Sheet 3.

Further south, the outcrop of the Nancy Lee Reef has been traced to the cross reef known as the "Iron Duke," which apparently has faulted it. At Drawbridge's "Engine" shaft (in the Golden Gate and Nancy Lee Consols) the Nancy Lee Reef is stated to have been met with about seventeen feet below the surface, and is supposed to extend to Drawbridge's Nancy Lee shaft, where it occurs at 199 feet below the surface.

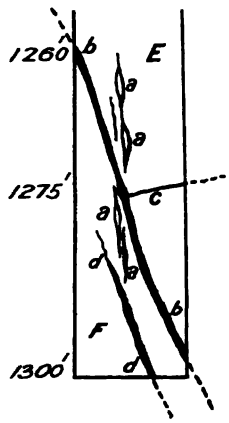
In the Nancy Lee Consols shaft, on No. 9 South Block, the Nancy Lee Reef was passed through at a depth of 300 feet below the surface, the Golden Gate Reef being penetrated at 100 feet lower down.

The whole of the workings of the Nancy Lee Reef is shown on Plans 2 (Sheets 2 and 3), 12, and 13, while other features are represented on Plate 6 and Plan 14. Fig. 2, Plate 6, represents a section in the P.C. underlie in which the effect of the faulting on the Nancy Lee Reef is shown. The footwall fault has, at an angle with the plane of section, broken through a roll in the granite below the reef, and has thrust the reef against the undisturbed portion of the roll in the footwall. The section on Plan 14 diagrammatically represents the Nancy Lee Reef to be faulted east of the "Engine" shaft, an effect necessitating the same reef outcropping again between this shaft and the Nancy Lee shaft. The section of the reef in the "Engine" shaft indicates the presence of a fault, but the surface features (*see* Plan 2, Sheet 3) indicate an uncertainty in this respect. Developments in future may reveal further information; but, in the meantime, no definite idea can be formed as to its behaviour.

Towards the south of Drawbridge's (Golden Gate and Nancy Lee Consols), the Nancy Lee Reef apparently outcrops to the west of Walsh's Block shaft (*see* Plan 2, Sheet 3), and is met with as a "formation" in the latter shaft at a depth of 78 feet from the surface (*see* Plan 14). To the south of Walsh's Block shaft the Nancy Lee Reef has not been traced.

Fig. 1

"Butcher Boy" Leader in Plants (G.C.G. Mines) Shaft



a. Veins of Fluorspar and Calcite

b. "Butcher Boy" (?) Leader, dips North Westerly, nearly vertical

c. Flat Leader, dips East 1 in 3

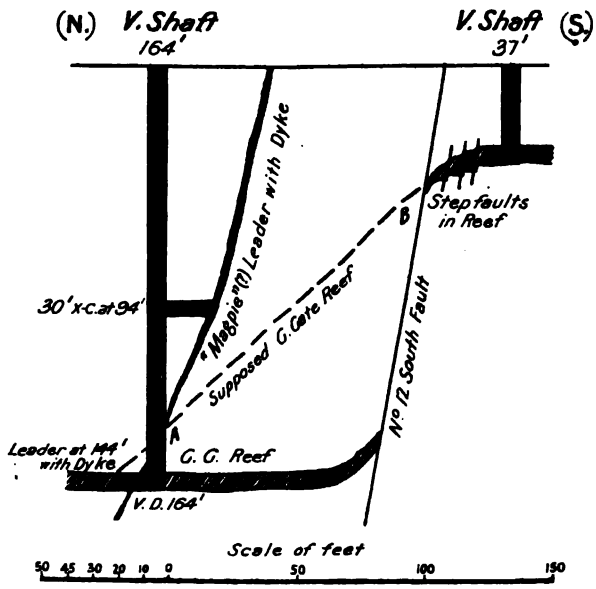
d. Small Leader parallel with "Butcher Boy"

E. Hard Syenitic Granite above "Butcher Boy"

F. Soft partly-decomposed Sy. Granite below "Butcher Boy"

Fig. 2

Section across Fault ("Break") at No. 12 South



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No. 7 SOUTH, No. 8 SOUTH (BALTIC), No. 8 SOUTH BLOCK, No. 9 SOUTH, No. 9 SOUTH BLOCK, No. 10 SOUTH, No. 11 SOUTH, AND No. 10-AND-11 SOUTH BLOCK.

On the lease known as No. 7 South Golden Gate, the surface workings show that a small fault has taken place at right angles with the Golden Gate Reef, and that in consequence the reef on the south side has been thrown back for some distance. The developments in this shaft (Threzeder's) will probably reveal the character of the fault and of the leaders traversing the Golden Gate Reef in an east and west direction.

In the No. 8 South Golden Gate (Baltic) the underlie shaft penetrated disturbed country, and was not further continued. In the adjoining mine (No. 9 Golden Gate) a continuation of this disturbance was met with at the bottom of the underlie close to the eastern boundary, where it is associated with an intrusive dyke. The depth at which the reef occurs in the latter mine, and in the No. 8 South Block to the east, shows that the disturbance has resulted in the reef being faulted along a line bearing north and south, with a downthrow on the west side. On the No. 8 South Block the workings show that the dyke has caused very little disturbance of the reef, but in the No. 9 South underlie there are a series of faults, along one of which the intrusion of a (?) dolerite dyke has taken place.

The section on Plan 12 shows the general inclination of the Golden Gate Reef, and also the faults in the No. 9 South, while diagrammatic sections illustrating the succession of faults in the bottom of the underlie in the same mine are given on Plate 7. Fig. 1 shows the Golden Gate Reef broken through by a dyke, with the top portion of the reef faulted from *a* to *b* on the footwall. The same reef is shown in another stage in Fig. 2, the portion to the left in that figure being faulted down on the hanging-wall of the dyke from *c* to *d*. Fig 3 illustrates the final movement, in which the reef and the fault and dyke have been driven from right to left along the thrust plane *g-h*, and dislocating the dyke at *e-f*.

In the No. 9 South Block the Golden Gate Reef falls over at an angle of 45° in the No. 4 level. The underlie to this followed the dip of the reef, but further down it has been continued in "formation." It was noticed, when the plans of the Golden Gate and Nancy Lee Reefs were being plotted, that the disturbance in the Golden Gate Reef marks the eastern limit of the gold-bearing stone, and that immediately above there is a similar disturbance in the Nancy Lee Reef which marks the boundary of the western limit of the gold-bearing stone. These features are illustrated in the vertical section on Plan 12, and their relative positions are shown on Plan 2, Sheet 3. Other references to the Nancy Lee Reef are given on page 26.

In the No. 10 South shaft a continuation of the fault observed in the No. 9 South Mine has not been seen, but probably it will be found to occur further west towards the outcrop, where the reef may be expected to have a downthrow on the western side. The underlie in the No. 11 South lease has passed into a large body of quartz and "formation" having a thickness of about thirty feet, the walls of which are at present unknown.

The workings connected with the No. 10-and-11 South Block shaft have not resulted in the discovery of rich stone, and this may be said also of the deep shaft in the Nancy Lee Consols. The latter shaft is sunk to a depth of 420 feet, the Nancy Lee Reef and the Golden Gate Reef being passed through at 300 and 400 feet respectively. Plans 2 (Sheet 3), 12, and 13 show the underground workings of No. 7 South, No. 8 South, No. 9 South, No. 10 South, No. 11 South, No. 8 South Block, No. 9 South Block, and No. 10-and-11 South Block, together with a diagrammatic section across the Golden Gate Reef from the outcrop on the west side of the field to the deep ground at the bottom of Plant's (G.G.G.M.) shaft.

The alternations of poor and rich stone in the No. 8 South Mine is illustrated on Plate 6, Fig. 3. The section is typical of this part of the Golden Gate Reef, and the data accumulated indicate that the deposition of stone has taken place at two distinct periods.

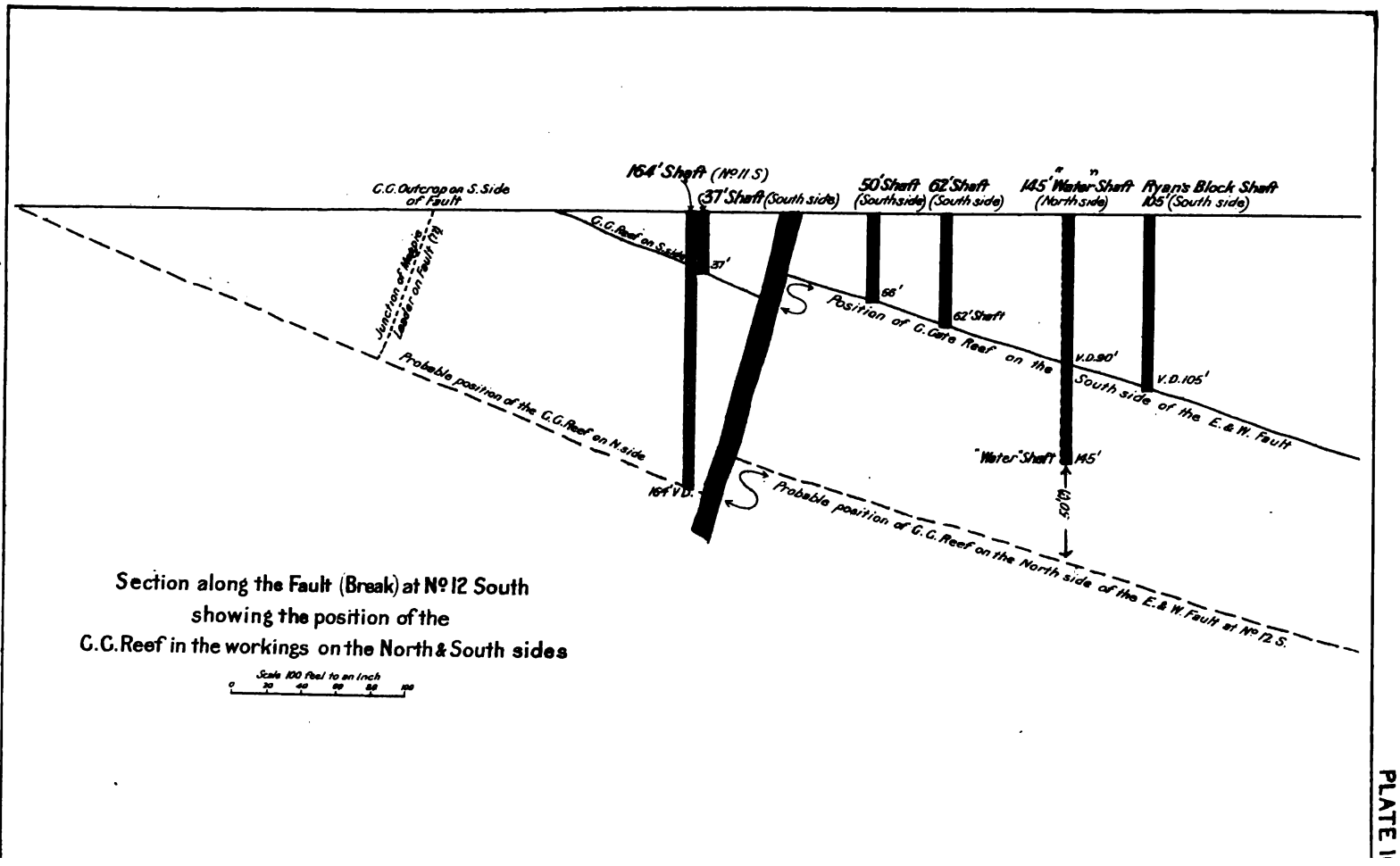
Fig. 1 on the same plate (No. 6) diagrammatically illustrates the possibility of the Nancy Lee Reef being portion of the Golden Gate Reef, particulars of which have previously been referred to.

PLANT'S (GOLDEN GATE GOLD MINES) SHAFT.

A section from the Golden Gate Reef outcrop, through the Nancy Lee Consols shaft to Plant's shaft, is represented on Plan 13. The two lines of reef shown in that section, if extended to the east and if persistent in their angle of dip, would meet between the Nancy Lee Consols shaft and Plant's shaft at the position marked *e*. In the latter shaft two defined quartz reefs were passed through, the top one at 804 feet, the other at 925 feet, the distance from one another being nearly the same as that between the Golden Gate and Nancy Lee Reefs in the Nancy Lee Consols shaft.

If the top reef in Plant's shaft at *d* corresponds with the top reef in the Consols shaft at *a*, its inclination must be considerably reduced from what is known of it between the Consols shaft and its outcrop further west. The inclination of the Golden Gate Reef, on the other hand, must have become greater, as the dip from the outcrop to *b* in the Consols shaft is less than from the latter position to *f* in Plant's shaft.

It may be supposed that the regular angle of inclination of the Golden Gate Reef has been maintained in going into the deep ground, that the Nancy Lee Reef, with its normally steep dip, has crossed the



Section along the Fault (Break) at No 12 South
showing the position of the
C.C. Reef in the workings on the North & South sides

(Illustrating Report on "Some Croydon Gold Mines")

PLATE I

former reef, and that in Plant's shaft it is below the Golden Gate Reef instead of above it. This would entail the crossing of the two reefs at *c*, and also a flattening of the angle of inclination of the Nancy Lee Reef between the two shafts. Were the steep angle of the latter reef continued to the east of the Consols shaft it would junction with the Golden Gate Reef at *e*, and if continued below the Golden Gate Reef, might be found at *f*, provided that, as mentioned previously, the Nancy Lee Reef has been thrust towards the west by sliding on the hanging-wall of the Gate Reef. In this position the continuation of the Nancy Lee Reef at *e* would be found below the Gate Reef at *g*, and from thence would be exposed at *f* in Plant's shaft. Between the two shafts the distance is very great, and nothing definite can be stated, but it will be seen that there are many problems to consider in view of future developments.

A section of Plant's shaft is shown on Plate 8. The upper portion of the section, it will be observed, is in granitic and felsitic rocks, most of the minerals of which are much decomposed. From this position to the bottom of the shaft the rocks are varieties of granite, but very seldom were they found free from alteration. The quartz and felspar are generally fresh, but the ferro-magnesian constituents have been more or less altered.

The first indication of a reef was observed at a depth of 350 feet, where eight inches of quartz, associated with a very thick belt of graphitic (plumbago) granite, was passed through.

At 550 feet, another belt of graphitic granite was met with in which quartzite inclusions were a conspicuous feature. All through the section of the shaft graphite has been found to be of common occurrence. On Plate 8 it is only mentioned in the references to the section where its presence is a prominent feature.

At 804 feet a reef six inches thick was passed through, with a soft "formation" and graphite on the footwall. This has generally been considered to be the continuation of the Golden Gate Reef. At 925 feet a second reef was penetrated. It is fifteen inches in thickness, and is contained within well-defined walls. This reef has been prospected by putting in a crosscut from the shaft below the reef, levels from which have been driven north and south along its course, the positions being shown on Plan 2, Sheet 2. A well-formed reef occurs in both levels, and contains gold, although not in payable quantities.

Another formation with quartz leaders was found at 1,090 feet, which, quite possibly, might be the Nancy Lee Reef. Were this to be the case, a further modification would be necessary of the theoretical considerations mentioned above.

There is no doubt the hope of finding gold in the deep ground has received a check through the work in Plant's shaft failing to discover a payable reef, but the prospects are by no means exhausted. There are immense gaps between the ore shoots which exist close to

the surface in the Golden Gate Reef, and it is quite possible for a number of shafts to be sunk without striking a payable shoot of stone in the deep ground, even were there several very rich shoots present.

Unfortunately, Plant's shaft was sunk in a very undesirable position, but this was not understood when operations began. After developments had proceeded for some time, it became a question whether operations should be suspended, or, in view of the large sum of money already spent without result, and because of the irregular behaviour of the rich ore shoots in the shallow ground which it was thought the shaft would intercept, whether the shaft should be continued to a greater depth.

The probability of being successful in obtaining a payable gold-bearing reef would undoubtedly have been greater had the shaft been sunk further north, and this opinion is expressed by nearly all those who are interested in the matter. All the circumstances point to the question being well worth further consideration.

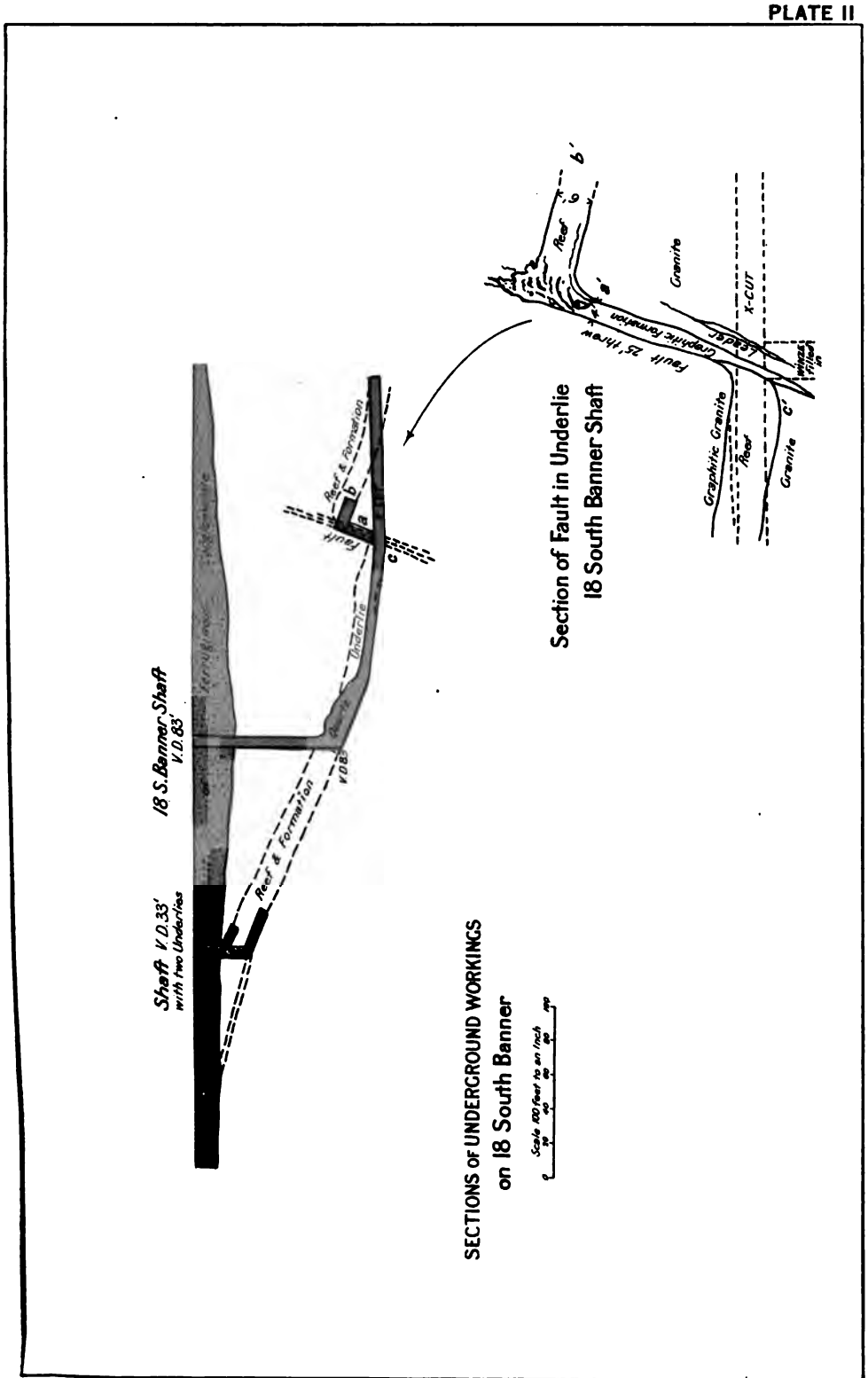
The cross leader in Plant's shaft at the depth of 1,060 feet appears to be a continuation of the "Butcher Boy" and "Magpie" Leaders occurring in the workings of the Nancy Lee Reef in No. 9 South and No. 10-and-11 South Block, and is referred to further on.

THE MAGPIE AND BUTCHER BOY LEADERS.

The Magpie and Butcher Boy Leaders many years ago constituted rather important features when the Nancy Lee Reef was being developed in the P.C. underlie in the No. 10-and-11 South Block. They are very narrow, seldom more than four or five inches thick, and pinch out in places to a very thin seam. They are, nevertheless, very persistent in their occurrence.

To the south-west of the P.C. underlie the Butcher Boy makes its appearance in the No. 10-and-11 South Block shaft, while further south-west in the No. 11 South, near the outcrop of the Golden Gate Reef, the vertical leader which has been found there is very probably an extension of the Magpie Leader. In the No. 11 South shaft it is found both in the hanging-wall and footwall of the Golden Gate Reef, and is associated with a decomposed dyke rock. It has a north-westerly dip, but is nearly vertical, and probably junctions along its strike with the fault known as the No. 12 South Break.

At the north-east extension of these two leaders, stone has been found on the surface between the P.C. Block shaft and Plant's shaft (*see* Plan 2, Sheet 2), and this led to the consideration of the probability of their extending into the latter shaft. If the line of strike of the Magpie Leader be extended to the north-east, the outcrop would pass about 300 feet south of Plant's shaft, and the Butcher Boy Leader, if it persists in being parallel, would be about fifty or sixty feet further north and nearer the shaft. The dip in all observed places shows a north-westerly inclination, and the Butcher Boy would therefore be



(Illustrating Report on "Some Croydon Gold Mines")

the one first penetrated in Plant's shaft. The strike and general character of the leader found in this shaft agree with that of the Butcher Boy, but the dip is not so steeply inclined. Fig. 1 on Plate 9 illustrates a section of this and other leaders found in Plant's shaft, and Fig. 2 on the same plate shows, among other features, the position of the Magpie Leader in the 164-feet shaft in the No. 12 South, close to the outcrop of the Golden Gate Reef.

THE IRON DUKE LEADER.

The Iron Duke Leader has been formed on the line of fault which dislocates the Nancy Lee Reef in the No. 10-and-11 South. It has a south-westerly extension, and apparently connects with the No. 12 South fault (or "break") in the water shaft in Ryan's Banner of Freedom. In this latter shaft a steeply inclined leader was passed through, and was supposed to be a continuation of the leader on the No. 12 South fault. This need not be so, however, and from an observation of the surface features (*see* Plan 2, Sheet 3) probably the No. 12 South fault will occur in the "water" shaft lower than the position at which this nearly vertical leader was found.

From previous experience many of the Croydon miners consider that where a reef rolls or falls over, the portion on the north side of the disturbance is very rich, but the probability of finding this particular fault following the rule is very remote. The fault has a downthrow of about 120 feet, so that on the north side the reef would be found about this depth, added to the depth of the reef below the surface on the south side. These features are shown in section on Plate 10. The "water" shaft is 145 feet deep, so it is stated, and would have to be sunk to about 200 feet to reach the Golden Gate Reef, provided, however, the reef was sheared without any steep folding to the north-north-east, which might reduce the distance twenty feet or more. The Golden Gate Reef, therefore, would probably be penetrated by sinking the "water" shaft from forty to sixty feet deeper.

THE NORTH AND SOUTH FAULT AND DYKE ("CLAY HEAD") IN No. 12 SOUTH GOLDEN GATE.

The fault occurring in the No. 12 South has a north-and-south trend, and is remarkable for the severe dislocation which it has produced in the Golden Gate Reef. The dyke found along this dislocation is, in places, between ten and twenty feet in thickness. Its position is shown on Plan 2, Sheet 3, and a cross-section is given on Plate 10.

In the "water" shaft a decomposed dyke occurs associated with the Magpie Leader, and is probably an offshoot from the larger dyke trending northerly to connect with those known in No. 10 South and No. 9 South. On the south end the dyke has been proved to continue for about 500 feet, and probably extends much further in

the same direction. From some information obtained regarding this dyke, evidently the down-throw becomes more severe as the distance south from the No. 12 South break becomes greater.

The effect of the north-and-south fault in producing changes of level on the Golden Gate Reef is rather confusing, as two outcrops of the one reef are produced. Near the No. 12 South fault the reef on the east side of the north-and-south fault rests against the dyke some depth below the surface, while further south, with the divergence of the line of strike of the reef and the dyke (*see* Plan 2, Sheet 3), the reef on the east side comes to the surface. On the west side of the dyke, near the No. 12 fault, the reef comes to the surface and forms an outcrop about 100 feet away. (*See* Plate 10.) Southward from this, the outcrop is continued until it is found opposite, and trends parallel with, the outcrop on the eastern side of the dyke, thus producing two outcrops of what once was a continuous reef.

THE BANNER OF FREEDOM (RYAN'S No. 12 SOUTH) AND DRAWBRIDGE'S (GOLDEN GATE AND NANCY LEE CONSOLS).

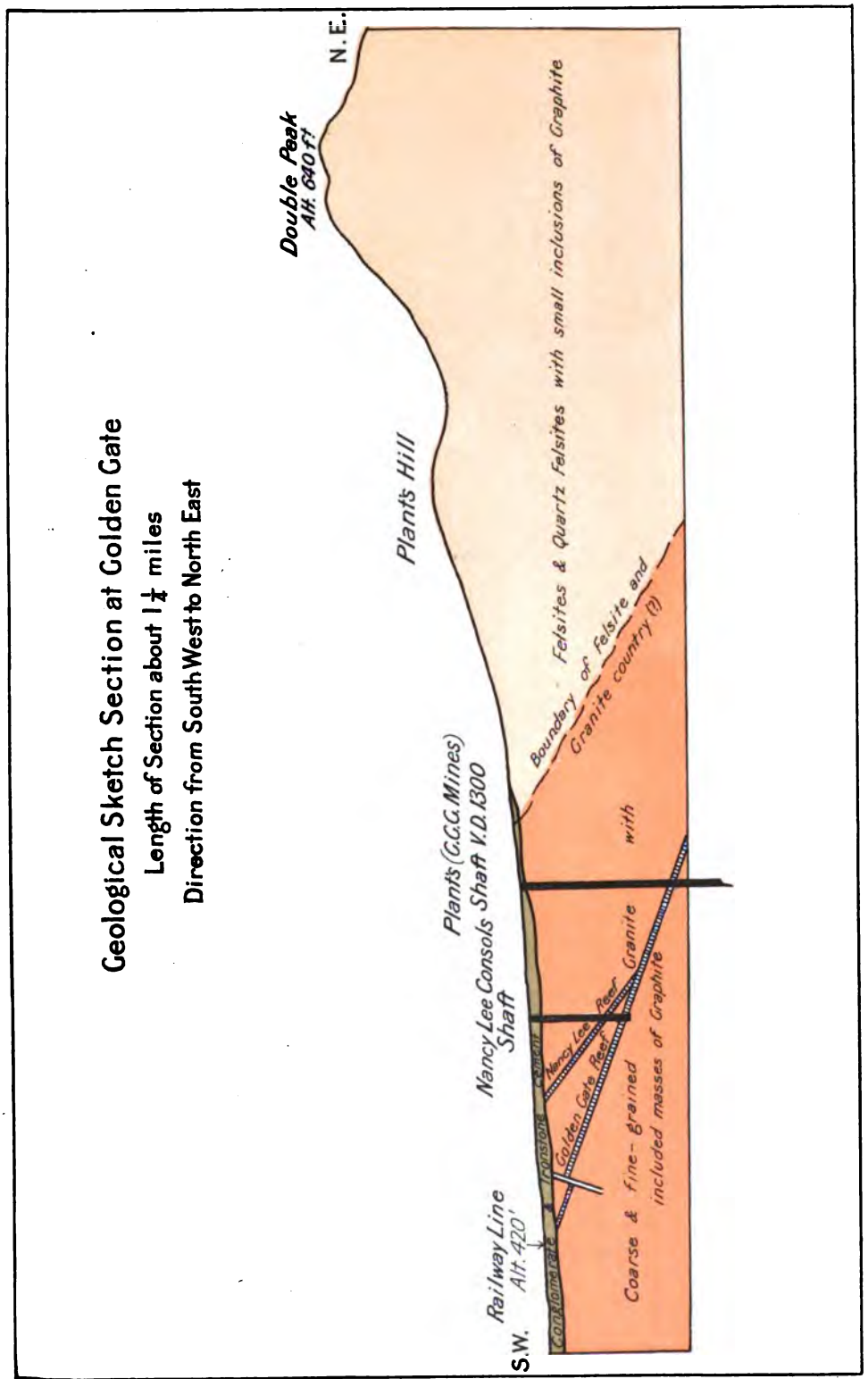
The workings on this part of the Golden Gate (*see* Plan 2, Sheet 3) have not produced very satisfactory results, partly because of the confusion resulting from the faulting of the reefs and the intrusion of the dykes, and partly because of the poor quality of the stone. There is, however, a large area of country which has not been prospected, and possibly better results may be obtained in future developments.

In Drawbridge's (Golden Gate and Nancy Lee Consols) two shafts have been sunk, one on the Nancy Lee Reef, the other on the Golden Gate Reef, but neither up to the present have produced payable stone.

Drawbridge's Engine shaft was sunk to a depth of 449 feet, and passed through a reef at seventeen feet, and another one at 200 feet. On this part of the field the distance between the Nancy Lee Reef and the Golden Gate Reef should be about 300 feet, and the finding of a reef not more than 200 feet below the Nancy Lee Reef was rather disconcerting. One cause of this can be explained on reference to Plan 14, where it is shown that a fault may bring two reefs close together.

MURRAY'S (No. 14 SOUTH BANNER BLOCK UNITED) AND WALSH'S (GOLDEN GATE AND BANNER BLOCK).

Murray's mine has yielded the largest amount of gold on this part of the Golden Gate line of reef, and recent prospects show that it will continue to be a gold producer in future. With the continuation of the underground developments in this mine, the prospects of Walsh's Block shaft and Drawbridge's Engine shaft are much improved.



(Illustrating Report on "Some Croydon Gold Mines")

Between Murray's and Drawbridge's, some disturbance has taken place in the country rock and the reef, but more development is required before its character can be determined. If the country has been faulted, as shown in the section on Plan 14, then the country in the eastern portion of the lease is disturbed. The rock passed through in Drawbridge's shaft could not be examined, however, so the deductions are made on evidence which a personal examination might considerably modify.

Walsh's shaft could not be inspected, the information contained in the section on Plan 14 being obtained from various sources. At a depth of seventeen feet from the surface a leader was passed through in the shaft, which might be the Nancy Lee Reef or a cross leader. At 78 feet a "formation" was met with which is very probably a continuation of the Nancy Lee Reef found further north. The dip of this formation could not be ascertained, but is assumed to be easterly. If, however, it has a westerly dip, it might be a continuation of the zone of disturbed country, referred to above as occurring between Murray's and Drawbridge's. No opinion can be expressed other than that just given concerning the mining prospects at Drawbridge's and Walsh's Block, as both of these mines were closed down during the period of examination of the line of reef.

MINES SOUTH OF MURRAY'S (14 SOUTH BANNER BLOCK UNITED).

General.—Very little mining development has taken place south of the workings at Murray's mine, and all the prospecting shafts which have been sunk have failed to yield satisfactory results. Some shafts have been put down without finding any reef at all, while in others the reef has been found, but without any gold in it. Nearly all the prospecting has revealed a "formation" (with or without quartz), which is very persistent in its occurrence throughout this part of the field. The gold has been found in irregular masses of quartz or in veins that pinch out to threads, but the stone has not proved sufficiently rich to warrant operations being undertaken on a large scale.

From general considerations it may be taken for granted that—(1) the Golden Gate Reef hereabouts is exceedingly patchy; that (2) a formation is almost always present; and that (3) although rich patches of quartz may be expected to occur, nothing has been shown by developments to indicate any favourable outlook in the future. (*See* Plan 2, Sheet 3.)

No. 18 South Banner Shaft.—A section of the workings in this shaft is given on Plate 11, and shows the occurrence of the reef and formation. The fault shown thereon has a north-north-east strike, which, if extended, would pass to the east of Walsh's Block shaft. An enlarged section of this fault is also given on Plate 11, illustrating

the dislocation of the reef by a downthrow of twenty-five feet to the north-west, and the bending of the reef at the point of shearing. Between the walls of the fault a graphitic formation exists, which is in places several feet thick.

A winze has been sunk near the fault for the purpose of finding the continuation of the reef on the eastern side, but the section illustrated on Plate 11 shows unmistakably that the reef would be found again by rising above the underlie and not by going below.

Further south (*see* Plan 2, Sheet 4) other mines have been opened, the most recent being Ladam's claim, where a large body of irregularly formed quartz has been exposed, and which at one time presented very promising features.

NOTES ON OTHER CROYDON MINES.

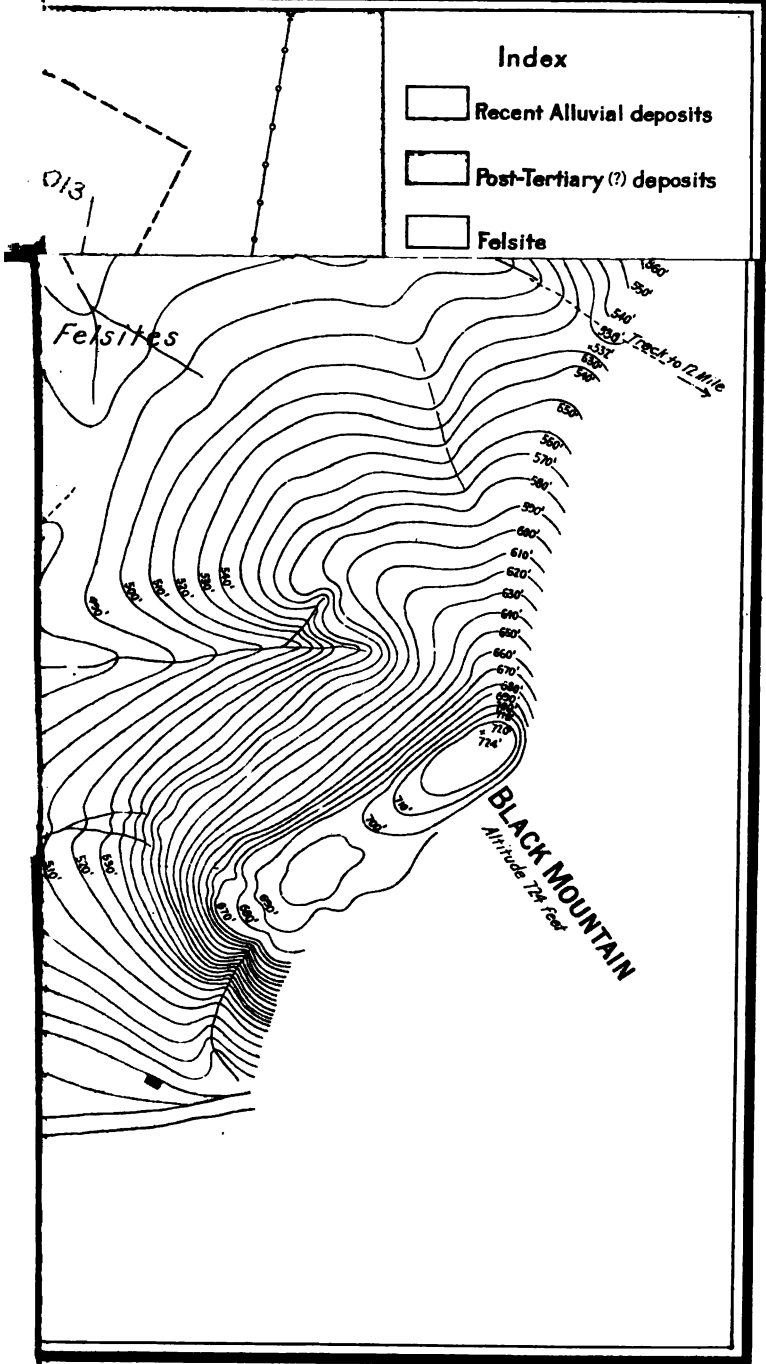
Several of the outlying fields in the Croydon district have been visited for the purpose of obtaining a general view of the mining developments carried on during recent years, but no attempt was made to examine in detail their geological or mining features, further than that required at the time when advising on any prospecting operations being undertaken.

The Harp of Erin, True Blue, Lady Mary, Highland Mary, Colleen Bawn, Homeward Bound, Richmond, Mountain Maid, Federation, and the King of Wallabadah, are some of the reefs which have been cursorily examined, but the time necessary for making a detailed examination of each could not be given without interfering with the investigations then being carried on at the Golden Gate Reef.

All these lines of reef are very important, and in view of the splendid yields of gold which they have produced more attention should be given to their development. Methods of mining and gold-saving were very crude when many of the reefs were working years ago, but with the more up-to-date appliances for mining and treatment now on the field, and the later developments showing the reefs to be well-defined and permanent in depth, there is every indication of the Croydon Goldfield becoming a very important mining centre in years to come.

By Authority: George Arthur Vaughan, Government Printer, William street, Brisbane.

PLAN I



Printed at the Govt. Printing Office, Brisbane. 1905

F UNDERGROUND WORKINGS

(Lease 1017) and Nº 10 & 11 West (Claim)

Golden Gate Line of Reef

NSTAN F.G.S. ACTING GOVT GEOLOGIST

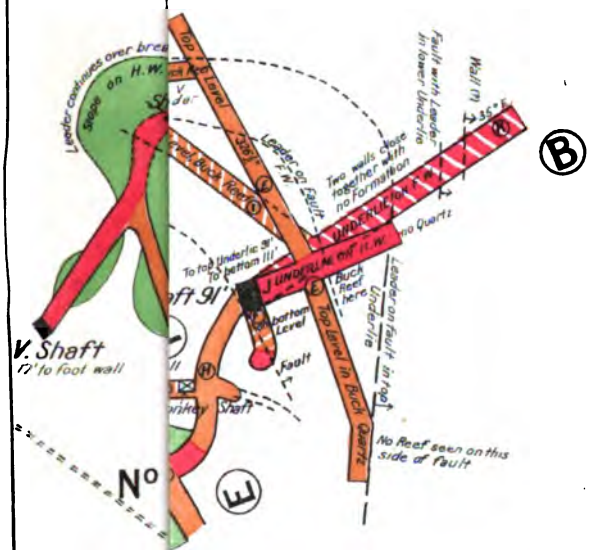
ating Report on the Croydon Gold Mines

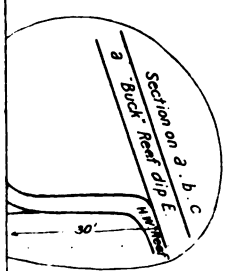
1904

Scale 40 feet to an inch

30 20 10 0 40

Drawn by H.W. Fox at the Geological Survey Office Br.sbane





PLAN 4

ONS OF UNDERGROUND WORKINGS

IN

orth (Lease 1017) and Nº 10 & 11 West (Claim)

Golden Gate Line of Reef

B. DUNSTAN F.G.S. ACTING GOVT GEOLOGIST

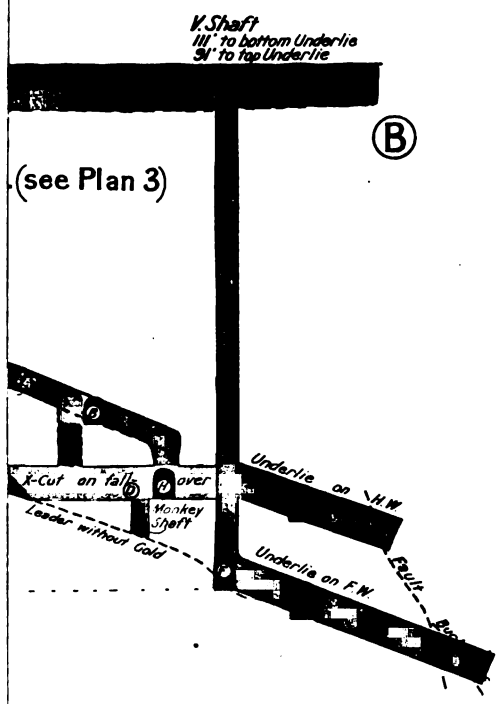
Illustrating Report on the Croydon Gold Mines

1904

Scale 40 Feet to an Inch

40 30 20 10 0 40

Drawn by H.W. Fox at the Geological Survey Office Brisbane



GEOLOGICAL SURVE

PLAN 5

5

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IC GOVT GEOLOGIST -

Croydon Gold Mines

n Inch

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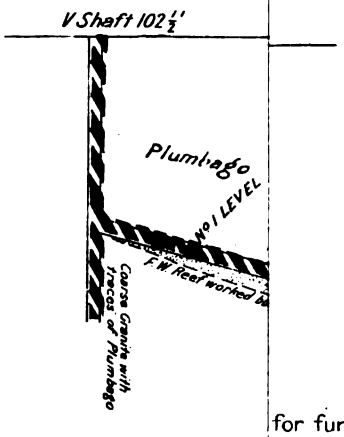
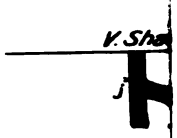
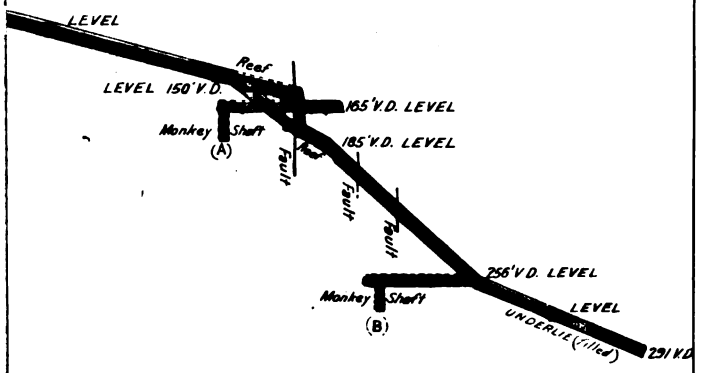


for further reference)



Nº 7 North
Section of Nº 1 Underlie



PLAN 6
F UNDERGROUND WORKINGS
IN
den Gate, & Nº 5 & 6 Golden Gate

AN F.G.S. ACTING GOVT GEOLOGIST

g Report on the Croydon Gold Mines

1904

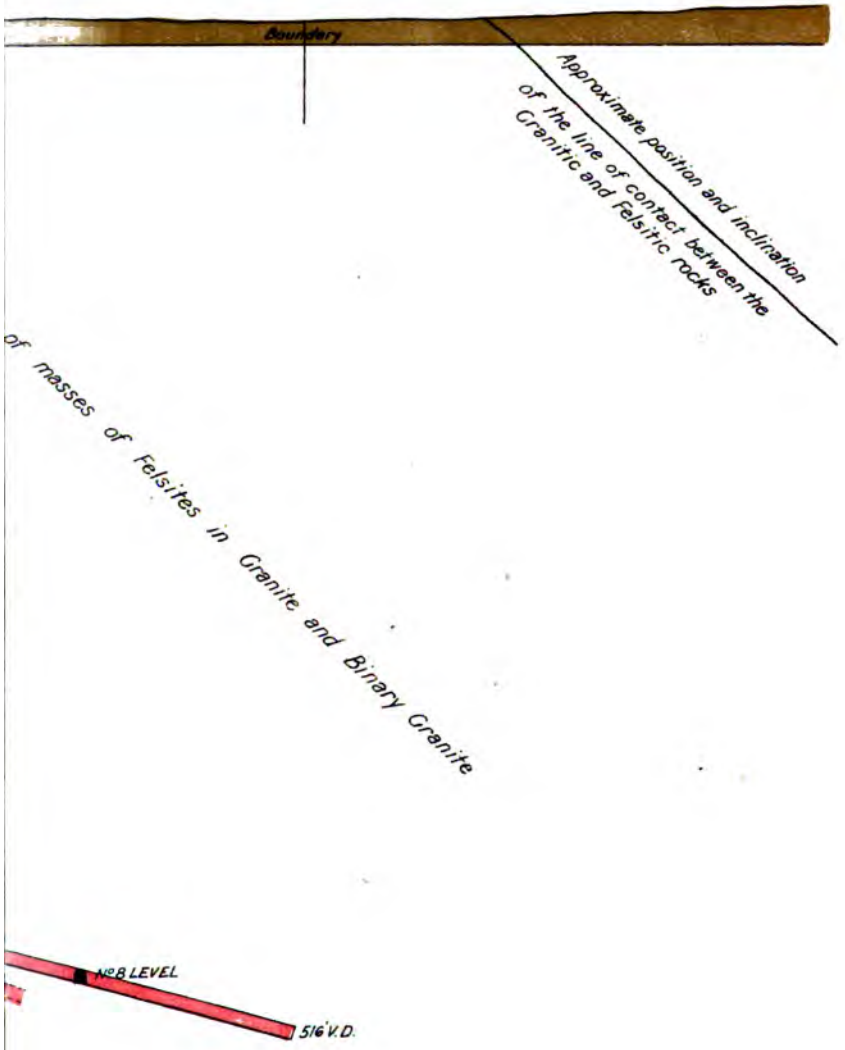
Scale 100 feet to an Inch

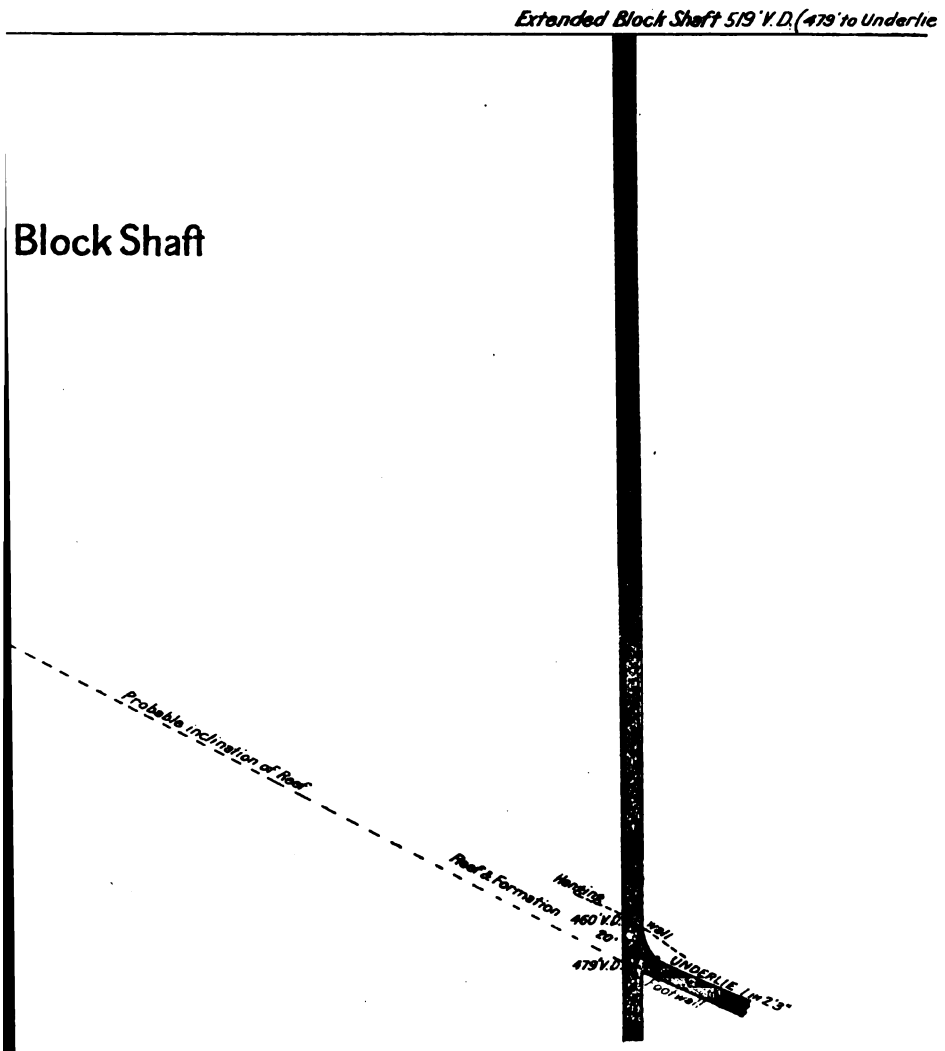
60 40 20 0 100

by H.W. Fox at the Geological Survey Office Brisbane

of masses

PLAN 7


Approximate position and inclination
of the line of contact between the
Granitic and Felsitic rocks
Boundary
of masses of Felsites in Granite and Binary Granite
No 8 LEVEL
516' V.D.



PLAN 8

SECTIONS OF UNDERGROUND WORKINGS IN

Rogers' No 1 (Golden Gate Limited)

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1904

Scale 100 feet to an inch

100 80 60 40 20 0 100

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PLAN 9

ONS OF UNDERGROUND WORKINGS

IN

Rogers' No 1, & No 1-&-2 South

Outcro

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1904

Scale 100 feet to an inch

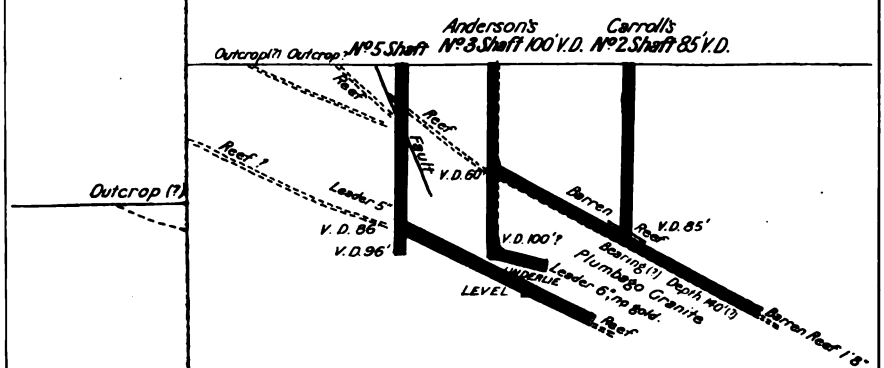
100 80 60 40 20 0 100

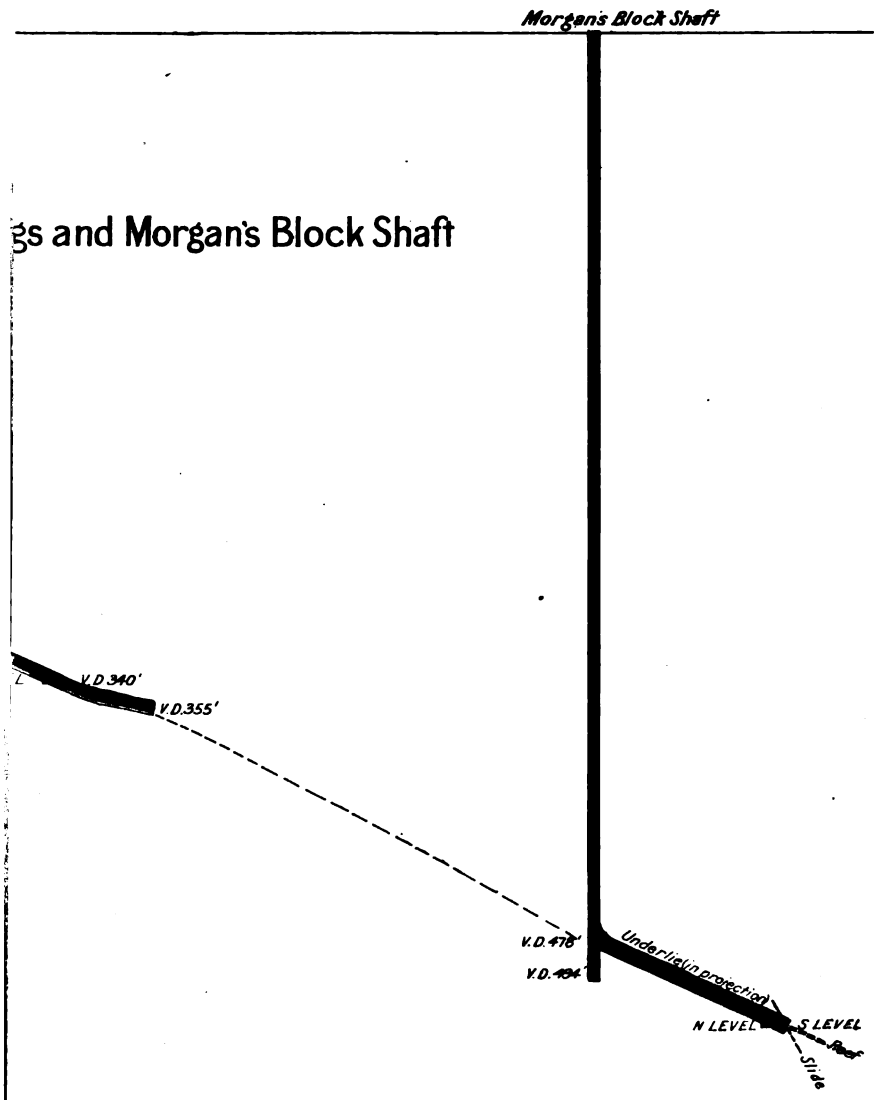
Drawn by H.W. Fox at the Geological Survey Office Brisbane

No 1 & 2 South

Carroll's, Anderson's and other Shafts

(see Plan 2a)





PLAN 10

SECTIONS OF UNDERGROUND WORKINGS

n Nº 3 and 4 South, G.G. United, and Morgan's Block

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1904

Scale 100 feet to an inch

100 80 60 40 20 0 100

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PLAN II

SECTIONS OF UNDERGROUND WORKINGS

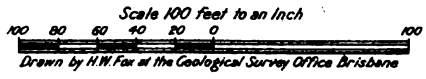
IN

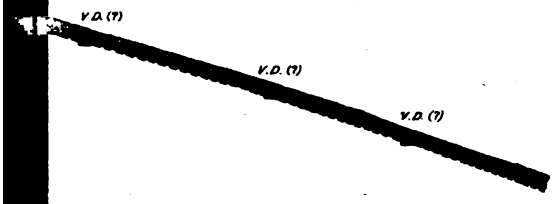
Nº 5 South C.C., Nº 4 & 5 South Block ("98") & C.C. & Nancy Lee United (Viles')

BY B. DUNSTAN F.G.S. ACTING GOVT GEOLOGIST

Illustrating Report on the Croydon Gold Mines

1904

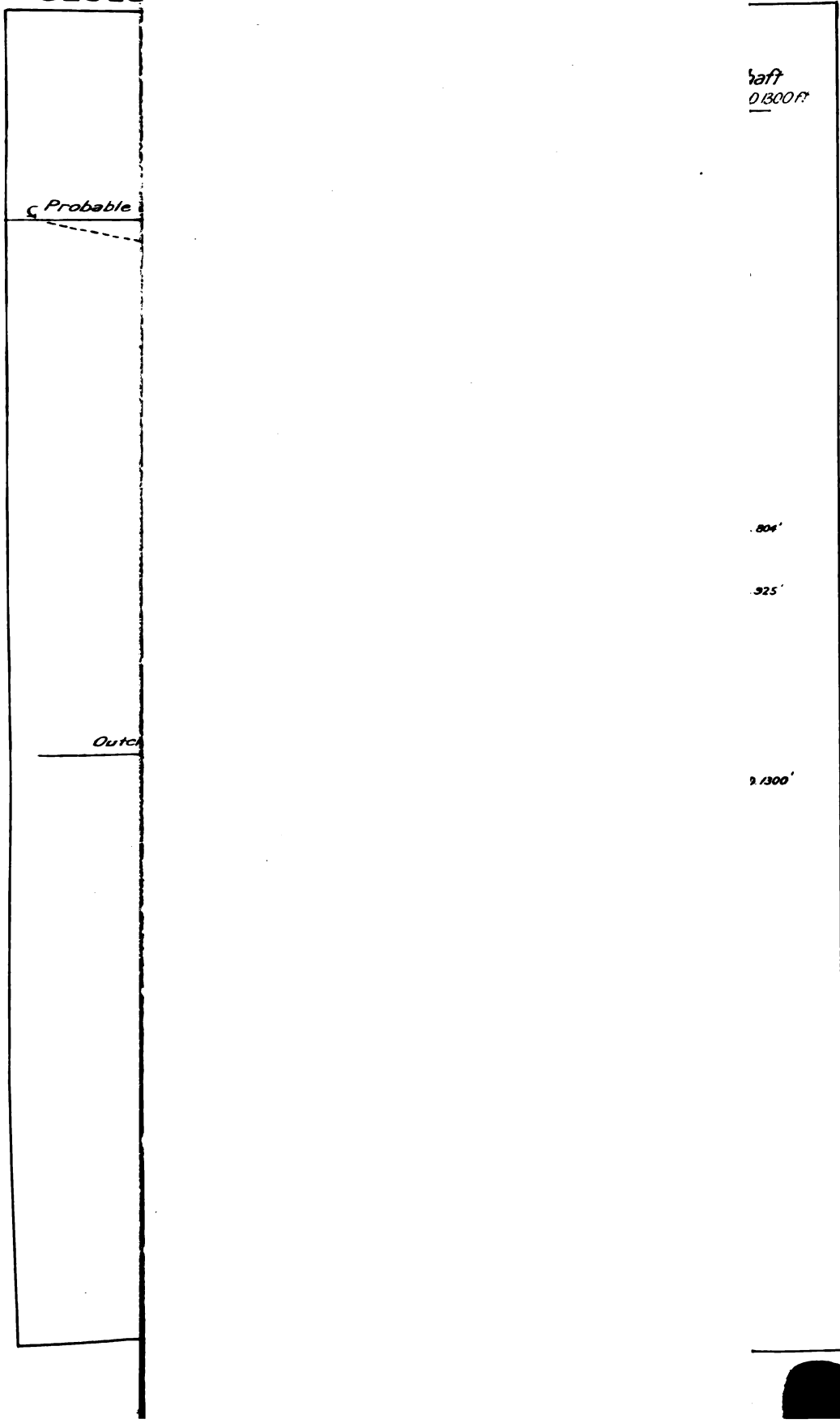




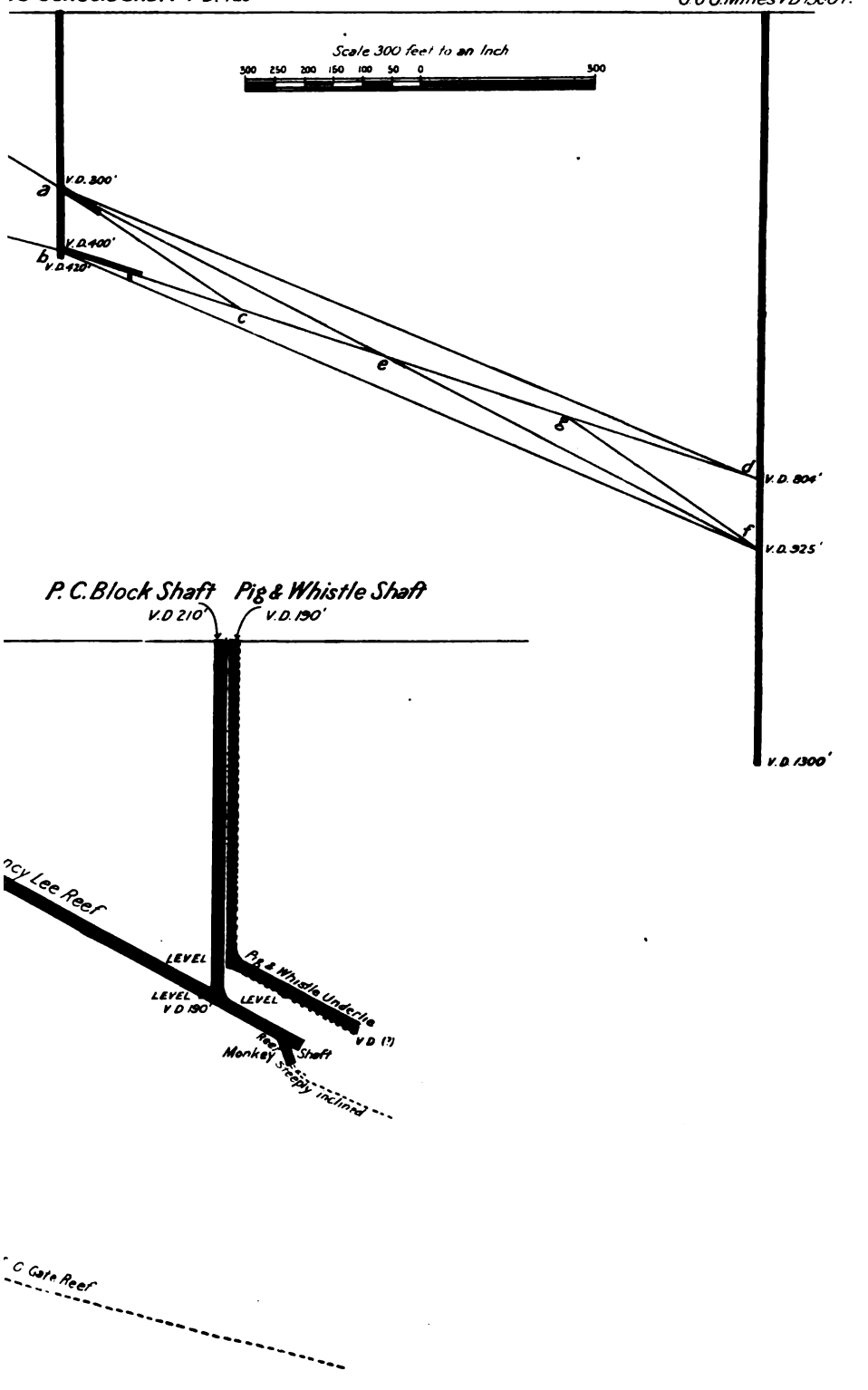
(See Plan 2ª for further reference)

GEOLO

'LAN 13



›ugh Nancy Lee Consols Shaft to Plant's Shaft



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